WEST VIRGINIA
GEOLOGICAL SURVEY

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VOLUME ONE A

PETROLEUM
AND
NATURAL GAS
PRECISE LEVELS

By I. C. WHITE, State Geologist.

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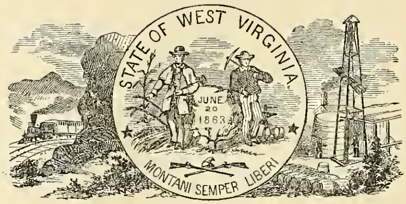
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LETTER OF TRANSMITTAL.

To His Excellency, Albert B. White, Governor of West Virginia, and President of the Geological Survey Commission:

SIR:—I have the honor to transmit herewith a supplementary Report on Petroleum and Natural Gas entitled Volume One A. The edition of Volume One on this subject had become entirely exhausted, and as the Survey received frequent requests for the same, the Commission authorized the publication of this supplementary volume to supply the demand in question. Then, too, the Survey has collected many valuable records of oil and gas well borings in the several regions of the State, the publication of which will prove of great value not only to those connected with oil and gas developments, but also to those interested in coal, since these records give exact measurements through the several geological formations, and in a more or less accurate manner indicate the presence or absence of valuable coal beds, together with their depths below the surface, and approximate thickness. The publication of these records is necessary for their preservation beyond the possibility of loss as well as to place them in a form available for use, and their value to the citizens of the State both now and for the future, fully warrants the comparatively small expense of printing. In the preparation of the text of this Report, the previous Volume One has been drawn upon quite freely, since much of it is of ever permanent interest, but the well records with a very few exceptions, are entirely new. Those added from Pennsylvania are published because they are contiguous to the West Virginia oil fields, and tend to aid our operators in their tireless search for these buried treasures which have added so much to the wealth and prosperity of the State. The Publication Committee has contracted for an edition of 5,000 copies of this report, 3334 copies of which are to be bound in cloth and the remainder in paper, and the Commission has fixed the price at $1.00 per copy for the paper binding, and $1.25 per copy for the cloth, delivered free to the purchaser by mail or express.

The receipts from the sales of publications (Vol. II, on Coal, and

the new State Map issued February 1st, 1904) have been sufficient to pay the entire cost of publication of the new State Map, as well as the expense for postage and express in the delivery of the Survey publications to the purchasers.

The commission has just authorized the preparation of Vol. III on Clays, Limestones, and Building Stones, and elected Prof. G. P. Grimsley of Washburn College, Topeka, Kansas, as Assistant Geologist, who will come to West Virginia, August 1st of this year, and take charge of the work on Volume III, which can probably be published early in 1905.

It is hoped that the data given in the present volume, may lead the citizens of our state to adopt less wasteful and extravagant methods of utilizing our still abundant stores of Natural Gas, and that the next Legislature will devise effective means for preventing the inexcusable waste and dissipation of this priceless heritage of the world's best and purest fuel.

Very respectfully,

I. C. WHITE,

Morgantown, July 1st, 1904. *State Geologist.*

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PREFACE

For the invaluable results of the oil and gas well borings recorded in this volume, the Survey is chiefly indebted to the courtesy of the great Oil and Gas producing companies, the officers of which have kindly given full information without stint. The geologic data thus given to the citizens of our domain practically free of expense, has cost the operators millions of dollars to secure, in their fruitful search with the drill. That they will spend many millions more in piercing the rocky envelope of the State for these treasures of light and fuel, goes without saying. The writer has endeavored to enlist the aid of the Carnegie Institution of Washington, D. C., in an effort to secure more carefully kept records rendered available to geology through this enormous expenditure of money in drilling for oil and gas in West Virginia, but as yet the officers of that Institution have failed to embrace this opportunity to add so immensely to the sum of human knowledge at only a small outlay in money. The great oil producing companies would most heartily co-operate in any such endeavor by giving facilities for securing samples of the drillings, making more numerous and accurate (steel line) measurements etc., but they cannot be expected to do such purely scientific work at their own expense, and entirely on their own initiative. If the survey could secure the funds to employ two men at modest salaries ($60 to $75 per month), one to attend the drill by day, and the other by night, recording measurements and securing samples from every sand pumping, the results thus obtained would prove of the greatest value, especially in the distant future of the State, when the search for oil and gas shall have long been ended with their exhaustion, and a

knowledge of the State's deeply buried coal resources shall prove of great value to her citizens. It is hoped that some means of securing and preserving such valuable data now rendered possible in so many counties, may soon be obtained before the enormous expenditures required in drilling operations shall have ended forever.

In the body of this volume due credit and acknowledgment are given for all records published, and while it is impossible to make formal announcement here of all who have thus aided the Survey, yet the following firms and corporations have done so much in this line, that the Survey cannot refrain from this public recognition of their aid and courtesy:

The officers and employees of the Battelle Oil Co., Bendum Bros., Burt Oil Co., Cabell Oil & Gas Co., Calf Creek Oil Co., Cairo Oil Co., Carnegie Natural Gas Co., Carter Oil Co., Chartiers Oil Co., Citizens Natural Gas Co., Clark Oil Co., Delmar Oil Co., Elk River Oil & Gas Co., Elkton Oil & Gas Co., Fairmont & Grafton Gas Co., Fayette County Gas Co., Fearless Oil Co., Federal Oil Co., The Fisher Oil Co., Fort Pitt Gas Co., Gartlan Drilling Co., J. M. Guffey & Co., Hartman Oil Co., Hope Natural Gas Co., Hurricane Oil & Development Co., E. H. Jennings & Bros., Kanawha Oil Co., Mandell Oil & Gas Co., Manufacturers Heat & Light Co., McCalmont Oil Co., New York Petroleum Co., Philadelphia Co., Roberts Bros., Southern Oil Co. & Fred S. Rich, South Penn Oil Co., Stumptown Oil & Gas Co., Syndicate Oil & Gas Co., Triple State Oil & Gas Co., Union Oil Co., U. S. Coal & Oil Co., U. S. Oil Co., Virginia Oil & Gas Co. and the Walton Oil & Gas Co.

ERRATA.

Page 6, line 9 from top, for "aniamls," read animals.
" 6, line 12 from top, for "conquerer," read conqueror.
" 10, line 4 from top, for "ingenius," read ingenious.
" 11, line 10 from top, for "irridescent," read iridescent.
" 26, line 5 from top, for "rus" read runs.
" 37, line 8 from bottom for "comparee," read compares.
" 49, line 13 from bottom for imposible," read impossible.
" 51, line 17 from top for "vis" read viz.
" 52, line 7 from top for "hense," read hence.
" 54, line 2 from bottom for "acumulation," read accumulation.
" 58, line 9 from bottom for "lige," read like.
" 226, line 16 from top for "utilzing," read utilizing.
" 235, line 14 from top for "7 5-8," read 5 5-8.
" 356, line 13 from top for "refered," read referred.
" 358, line 20 from top for "Southen," read Southern.
" 415, line 15 from top for "suspect," read suspected.

PART I

PETROLEUM AND NATURAL GAS

CHAPTER I

HISTORICAL SKETCH

Volume I, of the West Virginia Geological Survey, published in 1898, was distributed gratis to whomsoever applied therefor. The result was that the limited edition (3,000 copies) of the same was practically exhausted before many persons and libraries that make good use of such publications, could be supplied. Some of the historical matter printed in that volume is of such permanent value to every one interested in the subjects of Petroleum and Natural Gas, that it will be quoted from freely in this publication for the benefit of those who could not procure Volume I.

The early history of *petroleum* and *natural gas* is much the same in every country where they occur. In China the utilization of natural gas antedates authentic history. In Persia, Arabia, India, Albania, and other countries, rock oil, or petroleum, and its residuum, pitch, have been in use for many centuries, as attested by such writers as Aristotle, Strabo, Plutarch, Pliny, Marco Polo and others, while the ruins of the ancient temple of the Parsees or Fire-worshipers at Baku, where natural gas and petroleum have been issuing from the earth,

and bubbling up through the waters of the Caspian Sea for untold ages, simply accentuate the story of every other country.

The ancient gravel pits near Titusville, Pennsylvania, show that the American Indian had some knowledge of the value of petroleum, before the white man had invaded the region, and it is quite probable that the "burning springs," and outflows of petroleum, on the Little and Big Kanawhas, Big Sandy and other streams of West Virginia, had already attracted the attention of the aborigines, and that they were making use of them in their own primitive way, long before the first white settlers crossed the Alleghanies.

Gen. Washington's Discovery of a Natural Gas Spring.

One of the earliest records of these natural gas vents or "burning springs" is of that on the Great Kanawha, nine miles above Charleston, near the crest of the Browntown anticlinal. General Washington visited this "burning spring" in 1775, and pre-empted it along with other lands given to him for military services by the State of Virginia. In his will this natural gas wonder, together with a square acre of ground around it, was deeded to the public forever, and the following reference to its acquisition is recorded: "The tract of which the 123 acres is a moiety was taken up by Gen. Andrew Lewis and myself for, and on account of, a *bituminous spring,* which it contains, of so inflammable a nature as to burst forth as freely as spirits and is nearly as difficult to extinguish."

Drilling Machinery and Methods Invented in the Great Kanawha Valley.

It is not generally known that all of the essential elements of the petroleum industry of the United States really originated in what is now West Virginia, but such is the truth of history. It was in the Great Kanawha Valley at the Salt, or Buffalo Lick, near Charleston, where, under the intelligent and successful attempts of the Ruffner Bros. (David and Joseph) to bore down through the rocks and ascertain the source of the famous salt spring, that modern *drilling tools, jars, casing,* and practically all of the oil well machinery in use at the present

day were invented. These boring operations were begun by the Ruffner Brothers (David and Joseph) in 1806, and their efforts were crowned with success on the 15th day of January, 1808. The story of these early drilling operations and inventions has been given in a detailed and interesting sketch by Dr. J. P. Hale,* President of the West Virginia Historical Society, Charleston, W. Va., in the "Resources of West Virginia," 1876, by M. F. Maury and Wm. M. Fontaine, Chapter XII, pages 274-305, and as that volume is now out of print, the main portion of the chapter is here re-produced, beginning with page 273, as follows:

The Early Drilling Operations of David and Joseph Ruffner in the Great Kanawha Valley.

"The Kanawha Salt Works are situated in Kanawha county, on the Kanawha river, commencing about three miles above Charleston and extending up the river for several miles, on both sides.

These "Licks," as they are called, have not only been known and extensively worked from the first settlement of the valley by the whites, but have been known and used from time immemorial by the Indian tribes, and frequented by swarms of buffalo, elk, deer, and other wild animals, before the advent of the white man.

In 1753, when all this region was an unknown wilderness, which had never been penetrated by the most adventurous white man, a party of Shawnees who dwelt upon the Scioto, in what is now Ohio, made a raid upon the frontier settlements of Virginia, in what is now Montgomery county. Having taken the settlers unawares, and after killing, burning and capturing prisoners, as was their custom, they retreated, with their captives, down New River, Kanawha, and Ohio, to their homes. One of these captives, Mrs. Mary Ingles who afterwards made her escape, and was returned to her friends, related that the party had stopped several days at a salt spring on the Kanawha river, rested from their weary march, killed plenty of game and feasted themselves on the fat of the land; in

*Dr. Hale, who gave the best efforts of his long and busy life to the interests of West Virginia, died in Charleston recently. With but little financial aid from others, he built and donated to the State the first capitol building at Charleston, in order that his native town might become the chief city of West Virginia, although the building of the state house, together with the occurrence of a destructive flood during the same time, practically swept away all of Dr. Hale's financial resources. As the founder and president of the State Historical Society until his decease, he accomplished much toward the preservation of the early history of the State he loved and served so well.

the meantime, boiling salt water and making a supply of salt, which was carefully packed and taken home with them to their western homes. This is not only the first account we have of salt making on the Kanawha, but anywhere else west of the Alleghanies. In fact, if there is any earlier record of salt-making from brine springs, anywhere in the United States, I am not aware of it.

The earliest settlement made by the whites in the Kanawha valley, was made by Walter Kelley and family, at the mouth of the creek, which bears his name, in the spring of 1774, several months before the battle of Point Pleasant, where the combined Indian tribes, under the celebrated Sachem, Cornstalk, were defeated and driven back by the Virginians, under Gen. Lewis.

Kelley and his family paid the forfeit of their lives to their temerity; they were all killed by the Indians; but after the battle of the Point, when there was greater security for life, the Valley was rapidly settled, mostly by Virginians, and in great part by the hardy soldiers who had followed Lewis to Point Pleasant.

The early pioneer settlers, in a wilderness, without communication with other settlements, except by foot or bridle paths, depended upon the Kanawha Licks for their scant supply of salt. In those days of simple economy and provident thrift, when everything useful was made the most of, the women's wash-kettles were put under requisition for a four-fold duty; they boiled the daily hog and hominy, and other wholesome, frugal fare; once a week they boiled the clothes, on wash day; semi-occasionally they boiled the salt water for a little of the precious salt, and every spring they went to the sugar camp, to boil the annual supply of maple sugar and molasses.

It is related that at one time, when there was an apprehended attack from the Indians, the few early settlers were posted at the mouth of Coal river, for protection. Being out of salt and suffering for the want of it, they sent some of their hardy and daring young men in canoes up to the salt spring, where they dipped the canoes full of salt water; and, getting safely back, the water was boiled, and the precious salt made under cover of the fort.

Among the earliest land locations made in the valley, was one of 502 acres, made in 1785, by John Dickinson, from the Valley of Virginia, to include the mouth of Campbell's creek, the bottom above and the salt spring. Dickinson did not improve or work the property himself, but meeting with Joseph Ruffner, an enterprising farmer from the Shenandoah Valley, Virginia, in 1794, and describing this salt spring to him, Ruffner became so impressed with its value, that he then and there purchased the 502 acres upon Dickinson's own report, without himself seeing it, agreeing to pay for it 500 pounds sterling without condition, and other sums conditioned upon the quantity of salt to be made which might increase the price to 10,000 pounds sterling. Having gone thus far, he sold out his Shenandoah estates, and in 1795 removed himself and family to Kanawha to look after his salt property. Upon arriving here, however, his penchant

for rich farming lands overcame him, and he purchased from George and William Clendenen the large river bottom of 900 acres extending from the mouth of Elk river up the Kanawha, and, upon 40 acres of which the village of Charleston had been laid out and started the previous year. This last purchase, and the subsequent attention to clearing and improving the farm diverted Ruffner's attention for a time, from the salt project; the delay was fatal so far as he was concerned; he did not live to execute his pet scheme or realize his cherished hopes. Dying in 1803, he willed the property to his sons, David and Joseph, enjoining it upon them to carry out, as speedily as practicable, his plans of building up extensive salt manufactories to supply not only the increasing local demand, but a larger and still more rapidly growing demand which was now coming from the many thrifty settlements throughout the Ohio Valley. During the elder Ruffner's life, however, he had leased to one Elisha Brooks the use of salt water and the right to manufacture salt, and in 1797, this Elisha Brooks erected the first salt furnace in Kanawha or in the western country. It consisted of two dozen small kettles set in a double row, with a flue beneath, a chimney at one end, and a fire bed at the other.

To obtain a supply of salt water, he sank two or three "gums," some 8 or 10 feet each in length, into the mire or quick-sand of the salt lick, and dipped the brine with a bucket and swape, as it oozed and seeped through the sands below.

In this crude rough and ready way, Brooks managed to make about 150 pounds of salt per day, which he sold at the kettles, at 8 to 10 cents per pound. No means were used to settle or purify the brine or salt, as the salt water came from the gum, so it was boiled down to salt in the kettles, with whatever impurities or coloring matter it contained. As it issues from the earth it holds some carbonate of iron in solution; when it is boiled, this iron becomes oxidized, and gives a reddish tinge to the brine and salt.

This Kanawha salt soon acquired a reputation for its strong taste, and its superior qualities for curing meat, butter, etc. A great many who used it and recognized these qualities in connection with its striking reddish color came to associate the two in their minds in the relation of cause and effect, and orders used to come from far and near for some of "that strong, red salt from the Kanawha Licks."

Almost the only mode of transporting salt beyond the neighborhood in those early days was by pack horses, on the primitive, back-woods pack-saddle. So much of this was done, and so familiar did the public mind become with the term, as used in that sense, that even to this day, among a large class of people, the verb "to pack" is always used instead of other synonymous or similar terms, such as carry, transport, fetch, bring, take, etc., and the "tote" of Old Virginia.

It was not until 1806, that the brothers, David and Joseph Ruffner, set to work to ascertain the source of the salt water, to procure,

if possible, a larger supply and of better quality, and to prepare to manufacture salt on a scale commensurate with the growing wants of the country.

The Salt Lick, or the "Great Buffalo Lick," as it was called, was just at the river's edge, 12 or 14 rods in extent, on the north side, a few hundred yards above the mouth of Campbell's creek, and just in front of what is now known as the "Thoroughfare Gap," through which, from the north, as well as up and down the river, the buffalo, elk and other ruminating aniamls made their way in vast numbers to the lick. I may mention en passant that so great was the fame of this lick, and the herds of game that frequented it, that the hunter, explorer, and conquerer of the "bloody ground" of Kentucky, Daniel Boone, was tempted up here, made a log cabin settlement, and lived on the opposite side of the river, on what is now known as the Donally farm or splint coal bottom. I have had from old Mr. Paddy Huddlestone, who died a few years ago, at nearly one hundred years of age, many interesting anecdotes of their joint adventures in hunting and trapping. Boone still lived here, in 1789-90, when Kanawha county was formed, and in 1791 served as one of the delegates for the county, in the Legislature at Richmond.

But to return to the lick and the operations of the Ruffner Brothers. In order to reach, if possible, the bottom of the mire and oozy quick-sand through which the water flowed, they provided a straight well-formed, hollow sycamore tree, with four feet internal diameter, sawed off square at each end. This is technically called a "gum." This gum was set upright on the spot selected for sinking, the large end down, and held in its perpendicular position by props or braces, on the four sides. A platform upon which two men could stand, was fixed about the top; then a swape erected, having its fulcrum in a forked post set in the ground close by. A large bucket, made from half of a whiskey barrel, was attached to the end of the swape, by a rope, and a rope attached to the end of the pole to pull down on, to raise the bucket. With one man inside the gum armed with pick, shovel and crowbar, and three or four to work the swape, the crew and outfit were complete.

After many unexpected difficulties and delays, the gum, at last, reached what seemed to be rock bottom, at 13 feet; upon cutting it with picks and crowbars, however, it proved to be but a shale or crust, about six inches thick, of conglomerated sand, gravel and iron. Upon breaking through this crust the water flowed up into the gum more freely than ever, but less salt.

Discouraged at this result the Ruffner brothers determined to abandon this gum and sink a well out in the bottom, about 100 yards from the river. This was done, encountering as before, many difficulties and delays; when they had gotten through 45 feet of alluvial deposit they came to the same bed of sand and gravel upon which they had started at the river.

To penetrate this they made a 3½ inch tube of a 20-foot oak log, by boring through it with a long shanked augur. This tube,

sharpened and shod with iron at the bottom, was driven down, pile driver fashion, through the sand to the solid rock. Through this tube they then let down a glass vial with a string to catch the salt water for testing.

They were again doomed to disappointment; the water, though slightly brackish, was less salt than that at the river. They now decided to return to the gum at the river, and, if possible, to put it down to bed rock. This they finally succeeded in doing, finding the rock at 16 to 17 feet from the surface.

As the bottom of the gum was square and the surface of the rock uneven, the rush of outside water into the gum was very troublesome. By dint of cutting and trimming from one side and the other, however, they were, at last, gotten nearly to a joint, after which they resorted to thin wedges, which were driven here and there as they would "do the most good."

By this means the gum was gotten sufficiently tight to be so bailed out as to determine whether the salt water came up through the rock. This turned out to be the case. The quantity welling up through the rock was extremely small, but the strength was greater than any yet gotten, and this was encouraging. They were anxious to follow it down, but how? They could not blast a hole down there under water; but this idea occurred to them; they knew that rock blasters drilled their powder holes two or three feet deep, and they concluded they could, with a longer and larger drill, bore a correspondingly deeper and larger hole.

They fixed a long iron drill, with a 2½ inch chisel bit of steel, and attached the upper end to a spring pole, with a rope. In this way the boring went on slowly and tediously till on the 1st day of November, 1807, at 17 feet in the rock, a cavity or fissure was struck, which gave an increased flow of stronger brine. This gave new encouragement to bore still further; and so, by welding increased length of shaft to the drill, from time to time, the hole was carried down 28 feet, where a still larger and stronger supply of salt water was gotten.

Having now sufficient salt water to justify it, they decided and commenced, to build a salt furnace; but while building, continued the boring, and on the 15th of January, 1808, at 40 feet in the rock, and 58 feet from the top of the gum, were rewarded by an ample flow of strong brine for their furnace, and ceased boring.

Now was presented another difficulty; how to get the stronger brine from the bottom of the well, undiluted by the weaker brines and fresh water from above; there was no precedent here; they had to invent, contrive and construct anew. A metal tube would naturally suggest itself to them; but there were neither metal tubes, nor sheet metal, nor metal workers—save a home-made blacksmith—in all this region, and to bore a wooden tube 40 feet long, and small enough in external diameter to go in the 2½ inch hole, was impracticable; what they did do, was to whittle out two long strips of wood, two long half tubes of the proper size, and, fitting the edges

carefully together, wrap the whole from end to end with small twine; this with a long bag of wrapping near the lower end, to fit, as nearly as practicable, water tight, in the 2½ inch hole, was cautiously pressed down to its place, and found to answer the purpose perfectly; the brine flowed up freely through the tube into the gum, which was now provided with a water tight floor or bottom, to hold it; and from which it was raised by the simple swape and bucket.

Thus was bored and tubed, rigged and worked, the first rock-bored salt well west of the Alleghanies, if not in the United States. The wonder is not that it required eighteen months or more to prepare, bore and complete this well for use, but, rather, that it was accomplished at all under the circumstances. In these times, when such a work can be accomplished in as many days as it then required months, it is difficult to appreciate the difficulties, doubts, delays and general troubles that beset them then. Without preliminary study, previous experience or training, without precedents in what they undertook, in a newly settled country, without steam power, machine shops, skilled mechanics, suitable tools or materials, failure, rather than success, might reasonably have been predicted.

The new furnace which had for some time been under construction, was now complete. It was simply a reproduction of the Elisha Brooks kettle furnace on a larger scale. There were more kettles, of larger size, and better arranged.

On the 8th of February, 1808, the Ruffner Bros., made their first lifting of salt from this furnace, and simultaneously reduced the price to the, then, unprecedentedly low figure of four cents per pound.

From this time forward, salt making, as one of the leading industries of Kanawha, was an established fact, and Kanawha salt one of the leading commercial articles of the west; and wherever it has gone from the Alleghanies to the Rocky Mountains, from the Lakes to the Gulf, its superior qualities have been recognized and appreciated.

The neighboring property owners who had watched the progress and result of the Ruffner well with such deep interest, now instituted borings on their own lands, above and below, and on both sides of the river. Among these early enterprising experimenters were William Whitaker, Tobias Ruffner, Andrew Donally, and others. All were more or less successful in getting a supply of brine, at depths varying from 50 to 100 feet, and by 1817 there were some 30 furnaces and 15 or 20 wells in operation, making in the aggregate 600,000 or 700,000 bushels of salt.

In this year an important revelation in the manufacture of salt was effected by the discovery of coal. Although, in one of the finest coal fields in the world, coal had not, hitherto, been found here in workable seams, nor been used at all, except for blacksmith purposes. Wood had been the only fuel used in salt making, and for other purposes, and all the bottoms and convenient hill slopes for several

miles up and down the river had been stripped of their timber to supply this demand.

David Ruffner, true to the spirit of enterprise, and pluck, which bored the first well, was the first here to use coal as a fuel. This would appear to be a very simple matter now; but was not so then. It was only after many months of discouraging effort, and failing experiments, that he finally succeeded in getting it to work to his satisfaction. Its value established, however, its use was, at once, adopted by the other furnaces, and wood ceased to be used as a fuel for salt making in Kanawha.

Other important improvements were gradually going on in the manner of boring, tubing and pumping wells, &c. The first progress made in tubing, after Ruffner's compound wood-and-wrapping-twine tube, was made by a tinner who had located in Charleston to make tin cups and coffee pots for the multitude. He made tin tubes in convenient lengths and soldered them together as they were put down the well. The refinement of screw joints had not yet come, but followed shortly after, in connection with copper pipes, which soon took the place of tin, and these are recently giving place to iron.

In the manner of bagging the wells, that is, in forming a water-tight joint around the tube to shut off the weaker waters above from the stronger below, a simple arrangement, called a "seed bag," was fallen upon, which proved very effective, which has survived to this day, and has been adopted wherever deep boring is done, as one of the standard appliances for the purpose of which it is used. This seed-bag is made of buckskin, or soft calf-skin, sewed up like a sleeve of a coat or leg of a stocking; made 12 to 15 inches long, about the size of the hole and open at both ends; this is slipped over the tube and one end securely wrapped over knots placed on the tube to prevent slipping. Some six or eight inches of the bag is then filled with flaxseed, either alone or mixed with powdered gum tragacanth; the other end of the bag is then wrapped like the first, and the tube is ready for the well. When to their place —and they are put down any depth, to hundreds of feet—the seed and gum soon swell from the water they absorb, till a close fit and water-tight joint are made.

The hydraulic contrivance for raising salt water from the gums, consisting of a bucket, a swape and a man, was simple, slow and sure; but the spirit of progress was abroad and it soon gave place to a more complicated arrangement, consisting of a pump, lever, crank, shaft, and blind horse or mule, that revolved in its orbit around the shaft. This was considered a wonderful achievement in mechanical contrivance, especially by the men who had worked the swapes.

For several years this "horse-mill" as it was called, was the only mode of pumping salt water on Kanawha, but in the fullness of time it also went to the rear in 1828 and the steam engine came to

the front, not only for pumping, but also for boring wells and various other uses.

In 1831 William Morris, or "Billy" Morris, as he was familiarly called, a very ingenius and successful practical well borer, invented a simple tool, which has done more to render deep boring practicable, simple and cheap, than anything else since the introduction of steam.

This tool has always been called here "Slips," but in the oil regions they have given it the name of "Jars." It is a long double link with jaws that fit closely, but slide loosely up and down. They are made of the best of steel, are about 30 inches long, and fitted, top and bottom, with pin and socket joint, respectively. For use they are interposed between the heavy iron sinker, with its cutting chisel bit below and the line of augur poles above. Its object is to let the heavy sinker and bit have a clear, quick, cutting fall, unobstructed and unencumbered by the slower motion of the long line of augur poles above. In the case of fast augur or other tools in the well, they are also used to give heavy jars upward or downward, or both, to loosen them. From this use the oil well people have given them the name of "Jars."

Billy Morris never patented his invention, and never asked for nor made a dollar out of it, but as a public benefactor he deserves to rank with the inventors of the sewing machine, planing machine, printing cylinders, cotton gin, &c.

This tool has been adopted into general use wherever deep boring is done, but, outside of Kanawha, few have heard of Billy Morris, or know where the slips or jars came from.

The invention of this tool, the adoption of the heavy sinker and some other minor improvements in well boring, gave a great impetus to deep boring in Kanawha. Wells were put down 500, 1,000, 1,500 and 1,800 feet, and one, the deepest in Kanawha, by Charles Reynolds, to about 2,000 feet. These borings would doubtless have been carried to a much greater depth, but that the fact soon got to be understood that the salt-bearing strata had been passed, and that no brines were obtained at a greater depth than 800 to 1,000 feet. The limit of the salt-bearing rocks is readily told by the character of the borings. Within this limit are sandstones, shale, coal, &c., of the Coal Measures lying nearly horizontal, though dipping slightly to the northwest; below is the Carboniferous Limestone which underlies the Coal Measures, and crops out 100 miles to the eastward. This limestone, when penetrated, is known to the well-borers as the "long-running rock," from the fact that a boring-bit will run a long time in it without being dulled.

No regular suites of samples of borings from the Kanawha wells have ever been kept. This is not important, however, as the strata are well known, and can be examined along the New River canon as they crop to the eastward.

The Kanawha borings have educated and sent forth a set of skillful well-borers, all over the country, who have bored for water

for irrigation on the western plains, for artesian wells for city, factory, private use, for salt water at various places, for oil all over the country, for geological or mineralogical explorations, &c., &c.

Nearly all the Kanawha salt wells have contained more or less petroleum oil, and some of the deepest wells a considerable flow. Many persons now think, trusting to their recollections, that some of the wells afforded as much as 25 to 50 barrels per day. This was allowed to flow over from the top of the salt cisterns, on the river, where, from its specific gravity, it spread over a large surface, and by its beautiful irridescent hues, and not very savory odor, could be traced for many miles down the stream. It was from this that the river received the familiar nickname of "Old Greasy," by which it was familiarly known by Kanawha boatmen and others.

At that time this oil not only had no value, but was considered a great nuisance, and every effort was made to tube it out and get rid of it.

In 1775, Gen. Washington visited the Kanawha valley in person, and located some very valuable lands for his military services. About three miles above the Salt Lick, he set apart and deeded to the public, forever, a square acre of land near the river, on which was a great natural wonder, then little understood, called a "burning spring." For many years after, it was visited by every one who came to or passed through Kanawha, as one of the great curiosities of the region. It was simply a hole in the ground, which filled with water when it rained, and up through which issued a jet of gas, giving the water the appearance of boiling, and when lighted burned with a bright flame till blown out by high wind.

In 1841, William Tompkins, in boring a salt well a short distance above the burning spring, struck a large flow of gas, which he turned to account by "boiling his furnace" and making salt with it, effecting a great saving in fuel and economy in the cost of salt.

In 1843, Messrs. Dickinson & Shrewsberry, boring a few rods below, tapped at about 1,000 feet in depth, nature's great gas reservoir of this region. So great was the pressure of this gas, and the force with which it was vented through this bore-hole, that the augur, consisting of a heavy iron sinker, weighing some 500 pounds, and several hundred feet more of augur poles, weighing in all, perhaps 1,000 pounds, was shot up out of the well like an arrow out of a cross-bow. With it came a column of salt water, which stood probably 150 feet high. The roaring of this gas and water, as they issued, could be heard under favorable conditions for several miles.

It would have been difficult to estimate with any approach to accuracy, the quantity of gas vented by this well, and no attempt was made to measure it. I heard it roughly estimated as being enough to light London and Paris, with, perhaps, enough left to supply a few such villages as New York and Philadelphia. But as this is a salt well, as well as gas well, I suggest that the gas estimates be taken, cum grano salis.

While this well was blowing it was the custom of the stage

drivers, as they passed down by it, to stop and let their passengers take a look at the novel and wonderful display. On one occasion a professor from Harvard College was one of the stage passengers, and being a man of investigating and experimenting turn of mind, he went as near the well as he could get for the gas and spray of the falling water, and lighted a match to see if the gas would burn. Instantly the whole atmosphere was ablaze, the Professor's hair and eye-brows singed, and his clothes afire. The well-frame and engine-house also took fire, and were much damaged. The Professor, who had jumped into the river to save himself from the fire, crawled out, and back to the stage as best he could, and went on to Charleston, where he took to bed, and sent for a doctor to dress his burns.

Colonel Dickinson, one of the owners of the well, hearing of the burning of his engine-house and well-frame, sent for his man of affairs, Col. Woodyard, and ordered him to follow the unknown stage passenger to town, get warrant, have him arrested and punished, for wilfully and wantonly burning his property,—unless you find that the fellow is a natural d——d fool, and didn't know any better. Arriving at Charleston, Woodyard went to the room of the burnt Professor at the hotel, finding him in bed, his face and hands blistered, and in a sorry plight generally. He proceeded to state in very plain terms, the object of his visit, at which the Professor seemed greatly worried and alarmed, not knowing the extent of this additional impending trouble, which his folly had brought upon him. Before he had expressed himself in words, however, Woodyard proceeded to deliver, verbatim, and with great emphasis the codicil to Dickinson's instructions. The Professor, notwithstanding his physical pain and mental alarm, seemed to take in the ludicrousness of the whole case, and with an effort to smile through his blisters, replied that it seemed a pretty hard alternative; but under the circumstances, he felt it his duty to confess under the last clause, and escape. Well, said Woodyard, if this is your decision, my duty is ended, and I bid you good morning.

The salt water and gas from this well were partially collected and conveyed through wooden pipes, to the nearest furnace, where they were used in making salt.

For many years this natural flow of gas lifted the salt water 1,000 feet from the bottom of the well, forced it a mile or more through pipes, to a salt furnace, raised it into a reservoir, boiled it in the furnace, and lighted the premises all around at night. About the only objection to the arrangement was, that it did not lift the salt and pack it in barrels.

The success of this well induced other salt makers to bore deep wells for gas, and several were successful. Messrs. Worth & English, Tompkins, Welch & Co., Wm. D. Shrewsberry, J. H. Fry, and J. S. O. Brooks, got gas wells and used the gas either alone, or in connection with coal, for fuel, in salt making. Gas was also struck in a few other wells, but did not last long, and was not utilized.

The first flow of gas ever struck in Kanawha, was as far back as 1815, in a well bored by Capt. James Wilson, within the present city limits of Charleston, near the residence of C. C. Lewis, Esq.

The Captain had not gotten as good salt water as he expected; but instead of being discouraged, he declared in language emphatic, that he would have better brine or bore the well into ——— lower regions, with higher temperature.

Shortly after this the augur struck a cavity which gave vent to an immense flow of gas and salt water. The gas caught fire from a grate near at hand, and blazed up with great force and brilliancy, much to the consternation of the well-borers and others. Capt. Wilson thought it would be a reckless tempting of providence to go any deeper, and ordered the boring stopped.

This well is now owned by the Charleston Gas Light Company, which at some future time contemplates re-opening it to test the gas for lighting the city.

Of the many wells in the neighborhood that have furnished gas, some have stopped suddenly, and some by a slow and gradual process. Whether these stoppages have been from exhaustion of the gas, or sudden or gradual stoppage of the vent-ways, has not been definitely determined. It is known, however, that in the Dickinson and Shrewsberry well, which blew longer than any other, that the copper pipes in the well, and the wooden pipes leading to the furnace, were lined with a mineral deposit in some places nearly closing them. This deposit has not been analyzed, but may possibly be silicate of lime. A system of torpedoing might break up these incrustations from the walls of the well and rock cavities, and start the gas again.''

Natural Gas First Used for Manufacturing Purposes in the Kanawha Valley.

From these facts as given by Dr. Hale, it will be perceived that the claim of priority for West Virginia in all of the essential elements of the petroleum industry of the United States, is fully sustained, for here were invented practically all of those tools and appliances without which the deep drilling of the present day would be impossible. This record also shows that the use of natural gas for manufacturing purposes was first begun within the United States by Mr. Tompkins of the Kanawha Valley, a utilization which now plays such an important part in industrial affairs, and which is destined to continue until the *age of gas* is fully inaugurated, and the general use of coal in its crude or unmanufactured condition is abandoned in all populous communities. The extravagant methods which have characterized the first decade of the re-

cent greatly increased use of natural gas, will have been largely compensated for, should they finally lead to the use of coke instead of coal, and to the saving of the gas for fuel and general heating purposes which is now lost in our wasteful and unscientific coke ovens of the bee-hive pattern.

Petroleum Discovered in the Early Salt Borings.

In these early salt borings on the Great Kanawha, considerable quantities of petroleum were often found in the sands of the Coal Measures (Pottsville series,) and much of it was utilized in oiling machinery and for torch lights, while many barrels of it were transported and sold to other regions.

The methods of boring invented on the Kanawha soon spread to adjoining States, especially to Ohio, where in the Muskingum region, efforts to secure brine for salt manufacture, led to discoveries of petroleum and natural gas, just as they had previously done on the Great Kanawha.

Dr. Hildreth's Account of the Early Petroleum Industry.

Very fortunately for science, a learned and accomplished physician, who was also one of the pioneer geologists of Ohio, Dr. S. P. Hildreth, resided at Marietta during the early period in petroleum history, and he has left a carefully written account of these drilling operations and their results from which we get a glimpse of the beginning of the petroleum industry in Ohio, and by inference therefrom, its previous history in what is now West Virginia. This article was published in the American Journal of Science and Arts, Vol. X, New Haven, Connecticut, February, 1826, pages 1-8 inclusive, under the title of "Facts relating to certain parts of the State of Ohio," by S. P. Hildreth, M. D. After speaking of limestone that is thick and abundant, he continues on page 4 as follows:

"Below these beds of limestone you pass through a stratum of clay, sometimes of fossil coal; this is of various depths in different parts of the county*; after which you come to that vast and extensive bed of rock, which underlies the country from the Alleghany mountains to the Mississippi river, for aught I have heard. The thickness of this rock has never been ascertained, but at the depth of from 150 to 400 feet, this rock is strongly impregnated with salt and if on boring to that depth you are so fortunate as to find water, I believe that water invariably holds in solution a greater or less

*Washington county.

quantity of the muriate of soda. Two attempts at boring for salt water have been made in this county. The first was made two or three years since, about 40 miles from Marietta, near the Muskingum river; they proceeded to the depth of about 200 feet, and their prospects of obtaining water rather diminishing than increasing, they gave up the work. The other trial is now making, on the waters of Little Muskingum creek, about 12 miles from Marietta. It is two years since they began to bore, working at it only in the summer and autumnal months. They have penetrated the rock to the depth of 300 feet, and have as yet found no salt water; but the cattle are very fond of licking the fine dust of the rock, which comes up on the drills in the form of mud, which is an evidence that it contains salt. There is a continual discharge of carbonated hydrogen gas from the well; and also from the bed of the creek on which the well is situated, at various places for the distance of half a mile. This gas is highly inflammable, and where there is a free discharge of it, it will take fire on the surface of the water, on the application of a lighted stick, or the flash of a gun, and continue burning for days, unless put out by a heavy shower or a high wind. It was this discharge of gas that induced the present proprietors to search for salt water. It being invariably found to accompany all the salt water of any consequence, that has been discovered in the western country.*

'It is this discharge of gas that brings the salt water from such vast depths in the bowels of the earth, to the surface. And where water has been discovered, and the supply of gas has failed, the water has immediately sunk in the well, and could not, by any means used, be brought again to the top of the well.

They commonly bore, at the wells of Little Muskingum, to the depth of 400 to 500 feet, unless salt water is found before they reach that distance. They are encouraged then to continue, from their knowledge of the depth at which others obtained very good water, on the west branch of Duck Creek, four or five miles above the line of Washington, in Guernsey county. They have sunk two wells which are now more than 400 feet in depth. One of them affords a very strong and pure water, but not in great quantity. The other discharges such vast quantities of petroleum, or as it is vulgarly called, "Seneka Oil," and besides is subject to such tremendous explosions of gas, as to force out all the water, and afford nothing but gas for several days, that they make but little or no salt. Nevertheless the petroleum affords considerable profit, and is beginning to be in demand for lamps, in workshops and manufactories. It affords a clear, brisk light when burnt this way, and will be a valuable article for lighting the street lamps in the future cities of Ohio."

"The rock in which these wells are sunk is of various density and composition. In some places for one or two feet the workmen can gain only an inch or perhaps half an inch in a day, and then they

*Evidently referring to the Great Kanawha Valley.—I. C. W.

have their drills to sharpen every few minutes; the rock is so much harder than the hardest steel that it is very difficult to get a drill to stand it at all.

At other places in the rock they penetrate from one to two feet in a day. In this course of drilling they often pass through as many as three or four layers of fossil coal, at various depths in the rock; and it is generally the fact, that immediately after the salt water appears, they pass a stratum of stone coal of considerable thickness, perhaps six or eight inches.''

Early Use of Petroleum Shown by Dr. Hildreth.

This interesting account, it must be remembered, was published in 1826, and as may be seen from the same, petroleum was then coming into general use for illuminating purposes in the region. Now, as it is well known that the well borers of Ohio learned their art in the Great Kanawha Valley many years before (1806-1820) where much petroleum had been found in boring for salt, and utilized in the same manner as on the Muskingum, it can readily be seen that the Great Kanawha Valley region of West Virginia (then a part of Virginia) was the real pioneer in the discovery of petroleum by boring, and that it, as well as natural gas, was first utilized on a commercial scale in the Kanawha Valley; so that the account which Dr. Hildreth has left concerning the discovery and use of petroleum on the Muskingum might have been written fifteen years earlier for the Great Kanawha, had the geologist lived at Charleston instead of Marietta. As a matter of fact Dr. Hildreth did visit the Great Kanawha, as well as the Little Kanawha region soon after 1826, for in 1836 he published a long paper in the American Journal of Science, Vol. 29, entitled ''Observations on the Bituminous Coal Deposits of the Valley of the Ohio,'' in which on page 121 he describes the petroleum found in the salt wells near Charleston, the oil and gas on the Big Sandy (page 129,) and the oil pits on Hughes River (page 86.)

In another paper published in Vol. 24 of the same journal, in 1833, ''On the Saliferous Rock Formations in the Valley of the Ohio,'' page 46, he describes one of the earliest oil wells of the country, drilled in 1814, and located on the land of Mr. McKee, on Duck Creek. This well had been bored for salt water, and at a depth of 475 feet (evidently in the Dunk-

ard or Cow Run Sand) had struck a flowing oil well, which at first produced a large quantity of oil, "flowing 30 to 60 gallons at each eruption, but now (1833) only one barrel weekly."

Little Kanawha, Hughes River, etc.

The Little Kanawha river and its principal tributary, the Hughes, have also played very important parts in the early petroleum history of the country.

A prominent anticlinal axis crosses the Great Kanawha near the "burning spring," and probably the same uplift extending to the north across the Little Kanawha, the Hughes, the Ohio, and up into the Muskingum region, develops a line of *"burning"* and *petroleum "springs"* throughout its course, so that the Little Kanawha also had its *"burning springs,"* as well as the Great Kanawha. Where this arch crosses Hughes river near the California House, two miles below the junction of the North and South Forks, it brings one of the "shallow sand" oil rocks (Dunkard) above drainage level, and the oil seepage from this and the underlying beds had long ago filled the flood plain sands and clays with oil. Just when this surface deposit of oil was first observed, and collected, we have no authentic account, but probably from the earliest settlement of the region by the whites, and possibly earlier still by the aborigines. As related above, it was first described by Dr. Hildreth in 1836, who states that 50 to 100 barrels were collected and sold during each season, even at that early day, and hence the industry must have existed for many years before.

Early Oil Operations of Mr. George S. Lemon, on Hughes River.

The flood plain deposits or river sands which held the oil were situated on the right bank of the stream, and the first settlers dug pits into them, washed out the oil, and collected it with cloths and in other primitive ways for the markets at Parkersburg, Marietta, Cincinnati and elsewhere. One of the early operators engaged in the business of collecting and marketing this "mud oil," as it was called, of whom we have an authentic account, was George S. Lemon, who came from eastern Virginia in 1835 and settled at the forks of the Hughes

river. The oil deposits two miles below were well known at that time, and Mr. Lemon soon began the business of collecting and selling the oil. In his employ was an intelligent mulatto named Hugill, or Hugle, who had learned the well-borer's art on the Great Kanawha, and being in need of salt, Mr. Lemon concluded to sink a well for brine on the left bank of Hughes River, and 300 yards above the oil pit diggings, at a locality where he had noticed cattle licking the rocks. Aided by the inventive genius of Hugill, Mr. Lemon rigged up an arrangement for drilling the well by water power (probably the first of its kind in the country,) and thus the hole was soon drilled to a considerable depth, or to something over 100 feet, as remembered by Mr. Albert Lemon (son of George S.,) where a flow of salt water, oil and gas was struck. This was in 1844 according to Mr. Albert Lemon, and the oil rendering the salt water useless, the inventive talent of Hugill was again drawn upon. Through his assistance, Mr. Lemon perfected a siphon arrangement for automatically removing the water from the trough into which the well flowed, and in this manner about one barrel of oil was daily saved from the well, and added to the supply from the sand pits. This was termed *"sand oil,"* and was found to command a price higher in the markets, by five cents per gallon, than the *"mud oil"* from the sand diggings. The well continued to flow about once daily for a considerable time, but whether it was ever pumped for oil or not, after it ceased to flow, the accounts are conflicting. It was located about 150 yards from the mouth of Flint run, and the old timbers of the dam for water power, and the rocks between which the water turned the wheel may still be seen *in situ,* just under a modern well which now obtains its supply of oil from the upper portion of the *"Salt Sand"* at a depth of 600 feet.

Soon after Mr. Lemon had begun to market the oil from the pits and profits were accumulating therefrom, a question arose between him and Mr. Bushrod W. Creel concerning the title to the land on which the oil pits were situated. It appears to have been settled in favor of Mr. Creel, since we find his name on the books and records of the firm of Bosworth, Wells & Co., of Marietta, Ohio, as a seller of petroleum. A transcript from these old books which are in the possession of Mr. Tasker W. Bosworth, has been kindly furnished by the late

Mr. F. W. Minshall of Marietta, and as it possesses much historic interest, is given herewith as follows:

Transactions in Petroleum of Bosworth, Wells & Co., Marietta, Ohio, with Bushrod W. Creel, Hughes River, West Va.

SALES OF PETROLEUM.

J. Schoonmacher, Pittsburg, Pa.	
October, 1848, Seneca oil	$ 149.00
H. G. Farrell & Co., Peoria, Ill.	
October, 1848, Seneca oil	$ 89.95
July, 1849, Seneca oil	168.00
September, 1850, Seneca Oil	230.00
December, 1855, Seneca Oil	1231.00
Canby & Hatch, Baltimore Md.	
1851, Seneca Oil	78.05
E. H. Stabler & Co., Baltimore, Md.	
1851, Seneca Oil	$ 161.00
December, 1857, Seneca Oil	3080.13
B. A. Fahnestock & Co., Pittsburg, Pa.	
May, 1849, Seneca Oil	$ 120.00
Philadelphia Pa., sales.	
1851, D. Jayne & Son	36.22
Geo. D. Wetherell	155.00
J. Gilbert & Co	70.00
Samuel F. Troth & Co	15.00
E. & C. Yarnell & Co	25.00
Lynn, Smith & Co	167.36
1860, French, Richard & Co	1000.00
New York Sales.	
1851, Haviland, Harral & Risley	$ 190.00
Joseph E. Trippe	71.00
M. Ward & Co	350.00
1852, Olcott, McKesson & Robins	55.35
A. G. Bragg & Co	1804.00
Haskill, Merrick & Bull	50.00
1854, McKesson & Robins	394.00
1856, Hall, Dixon & Co	731.00

	Thomas W. Clark	357.00
1857,	Scheiffelm Bros. & Co	130.00
	Barnes & Park	82.65
	G. W. Westbrook	136.35
	Babcock & Co	60.00
	St. Louis, Mo., Sales.	
April, 1852,	Charles, Blow & Co	$ 306.80
	Cincinnati, Ohio, Sales.	
1853,	Burdsall & Bros	$1507.00
	Chicago Sales.	
1855,	E. M. Wells	$ 239.00
1856,	E. M. Wells	132.00

"The purchases from Bushrod W. Creel of Hughes River, W. Va., began in 1847 and continued regularly up to 1860. The price paid Creel from the beginning of the trade up to 1857, was 33 cents per gallon, delivered at Marietta, O. From 1857 to 1860 he was paid 40 cents per gallon.

The following entries taken from the credit side of the account with Mr. Creel, show the quantity purchased and the price at times named:"

January, 1855, 24 barrels, at 33 cents per gallon.
May, 1855, 9 barrels at 33 cents per gallon.
June, 1855, 29 barrels, at 33 cents per gallon.
July, 1855, 22 barrels, at 33 cents per gallon.
August, 1855, 32 barrels, at 33 cents per gallon.
September, 1855, 27 barrels, at 33 cents per gallon.
October. 1855, 29 barrels, at 33 cents per gallon.
November, 1857, 72 barrels, at 40 cents per gallon.
December, 1857, 153 barrels at 40 cents per gallon.

There were, of course, petroleum sales from the Hughes river region, as well as from the Great Kanawha, to many other parties, but the transactions with Bosworth, Wells & Co., are the only ones yet discovered, of which a written record has been preserved. These records are of much historic interest, since taken in connection with the petroleum discoveries in the salt borings on the Great Kanawha as early as 1808, as given by Dr. Hale, and those on the Muskingum, described by Dr. Hildreth in 1826, they show conclusively that a large (for the time) commercial business in petroleum was already in existence in Virginia and Ohio both from *drilled wells* and *sand*

pits, long before Col. Drake had completed (28th of August, 1859,) near Titusville, Pa., the first well bored specially for petroleum, and that, therefore, West Virginia should at least share with Pennsylvania the honor and credit of originating the great petroleum industries, and especially so in view of the fact that practically all well boring tools, methods of casing, drilling and pumping wells, were invented by citizens of what is now West Virginia.

Method of Pumping Several Wells from a Central Power Station, Invented by W. C. Stiles, Jr., of Volcano, W. Va.

The method of coupling several wells together and pumping all from one central power plant, thus enabling the producer to operate very small wells at a profit, was invented by the late Mr. W. C. Stiles, Jr., of Volcano, Wood county, W. Va., in 1874, and first applied in the Volcano field, where as many as forty wells were sucessfully operated by one engine under the superintendence of only one man. Mr. Stiles got the idea from seeing power transmitted by wire cables in Philadelphia, his former home, and his inventive genius successfully applied the same principle to the pumping of oil wells.

Drilling Operations of the Brothers Rathbone, at Burning Springs, on the Little Kanawha.

A small stream known as Burning Springs Run enters the right bank of the Little Kanawha river, 41 miles above the latter's mouth. The run was so named by the first settlers from the fact that natural gas came up in a sulphur or chalybeate spring, about one-half mile up the stream from its mouth, in such quantity that it could be set on fire over a space of several feet square. There were two of these springs, one known as the "Big" spring, and the other as the "Little" one. These phenomena early attracted the attention of capitalists, and in 1842 the brothers Rathbone came to Parkersburg from New York, and soon after purchased a tract of land containing 1,000 acres covering the region along Burning Springs run, and including the springs themselves.

Salt was then one of the articles of commerce which on account of its scarcity, commanded a high price, and there was much profit in its manufacture. Because natural gas springs occurred on the Great Kanawha, Muskingum and in other localities where good brines had been found, the Rathbone brothers concluded it would be possible to find good salt producing brines on their 1,000 acre tract. Hence soon after the purchase was consummated, arrangements were made to sink a well for salt, and it was located on the left bank of the Little Kanawha, 100 yards below the mouth of Burning Springs run. At a depth of 250 feet so much oil was obtained (from the Cow Run or Dunkard Sand,) that further attempts to find salt water were abandoned, and since the "gum" or conductor was left in the hole, the oil would rise to the top (as the hole was full of water) from which it was skimmed and sold. This old salt well was the first in the State to be pumped for oil alone, since soon after Col. Drake drilled his famous well near Titusville, Pa., the Rathbone salt well was leased and put to pumping. This was late in the fall of 1859, and it produced several barrels daily.

First Well Drilled for Oil in West Virginia.

The first well within the the boundaries of the State, drilled solely for petroleum, was also on the Rathbone tract, and located on Burning Springs run, a short distance (one-fourth mile) from its mouth. The well was drilled by the Rathbones and others from Parkersburg, and was begun late in the year 1859. Since the well was drilled with a "spring pole" it was not completed until about the 1st of May, 1860, when at a depth of 303 feet oil was encountered in the Cow Run or Dunkard sand, which produced at the rate of 100 barrels daily. The Rathbone tract was then sold to the Rathbone Oil Co. for a large sum, and the second well, finished by this Company late in the year 1860, came in at the rate of 40 or 50 barrels per hour at a depth of only 300 feet. These two wells brought the West Virginia oil territory into great prominence, and the developments followed so rapidly that the former village soon had a population of several thousand people, repeating the his-

tory of gold mining camps, and rich mineral discoveries in other regions.

Destruction of the Burning Springs Petroleum Industry.

At the height of this development in 1863, Gen. Jones of the Confederate forces appeared upon the scene, with his command of 3,000 cavalrymen, and setting fire to the oil accumulated in tanks, barrels and boats, destroyed in a day, it is estimated, not less than 300,000 barrels of oil, and effectually frightened away the northern capitalists who had invested their money in the Burning Springs field. The burned and abandoned wells became ''water-logged,'' and the region never recovered from the conflagration, although some oil is still produced there, and many wells have been drilled within the last few years.

Life of an Oil Well.

Two or three of the Burning Springs wells drilled in 1861 to the Dunkard or Cow Run Sand are still producing from one to two barrels daily, although 43 years old, and they never were large, thus showing that we do not yet know the maximum limit of life in an oil well.

Spread of Drilling Craze Over the State, and Failure of the Efforts to Reach the Oil Sands.

Soon after the Burning Springs oil development began, the petroleum craze spread all over the State, and large sums of money were paid by eastern capitalists for leases on tracts of land even far up in the mountain regions. Many wells were drilled in several counties, or at least attempts were made to drill them, which nearly always ended by getting the tools fast, and the hole plugged, because the operators had not yet learned the art of dealing successfully with rocks that crumble, or *cave,* and fall into the hole when water touches them. In the region of Titusville, Oil City, and all of north-eastern Pennsylvania the rocks (Sub-Carboniferous and Catskill) to be drilled through, are all hard and the walls of the wells stand firm

after the holes are bored, even though drilled "wet" and full of water from top to bottom, but when the Pennsylvania drillers came down into West Virginia where a much higher and softer series of rocks was encountered (Permian and Coal Measures,) and attempted to use the Pennsylvania methods, the result in most cases was failure to sink the borings to any of the Venango County oil producing sands. Thus it happened that the oil development of West Virginia outside of the Burning Springs and Volcano "oil break" or anticlinal, was delayed for 30 years behind her sister State on the north, for except along that bold arch between the Little Kanawha and Ohio rivers there was no oil production in commercial quantity until the year 1889. The region along the "Burning Springs—Eureka" anticlinal was practically all developed during the '60's, since here the soft rocks had been lifted into the air and eroded, so that Pennsylvania conditions existed, and it was possible to sink wells there without trouble from caving walls, hence the Burning Springs, Volcano, Vaucluse, and other oil pools along this anticlinal had been developed, and practically exhausted before the new developments, inaugurated in 1889, had begun.

Recent Petroleum History of West Virginia.

The modern development of the petroleum interests of West Virginia, date from 1889. The old development which started at Burning Springs in May, 1860, had practically ended with defining the producing territory along the Burning Springs anticlinal, since although many "shows" of oil had been found in several other portions of the State during the drilling craze of the '60's, yet for the reasons already given, none of these attempts had reached the main oil producing sands of Pennsylvania, although it has since been proven that many of these early shallow borings, which, owing to the condition of the well drilliing art could be sunk only a few hundred feet, were in reality located over rich pools of petroleum or natural gas.

Statistics of Oil Production.

The statistics of Petroleum production in West Virginia

are not perfect, especially for the early period of great development at Burning Springs, so that previous to 1876 the total for the State is merely an estimate. Subsequent to that date, the record is from the pipe line runs, and is therefore approximately accurate. These statistics are as follows, according to Oliphant in his Petroleum Reports for the U. S. Geological Survey:

	Barrels.
1859 to 1876	3,000,000
1876	120,000
1877	172,000
1878	180,000
1879	180,000
1880	179,000
1881	151,000
1882	128,000
1883	126,000
1884	90,000
1885	91,000
1886	102,000
1887	145,000
1888	119,448
1889	544,113
1890	492,578
1891	2,406,218
1892	3,810,086
1893	8,445,412
1894	8,577,624
1895	8,120,125
1896	10,019,770
1897	13,090,045
1898	13,603,135
1899	13,910,630
1900	16,195,675
1901	14,177,126
1902	13,513,345
1903	*12,900,000
Total	144,601,296

*Estimate by F. H. Oliphant.

Great Increase in West Virginia Petroleum Output, Dating from 1889.

These tables exhibit an almost steady decline from 1876 until the close of 1888, but here the tide turns, and there is a sudden increase. The year 1889 marked the opening of the

Dolls Run, Eureka, and Mannington oil pools, and from that time forward the growth of West Virginia's oil production has been upward with such marvelous strides that toward the close of the year 1900, it finally surpassed that of Pennsylvania, and the pipe line rus at the present time (May 1904,) show that her production equals that of Pennsylvania and New York, combined. This primacy in *"white sand"* oil (the purest and best petroleum in the world,) production will also very probably continue in the future, since West Virginia, occupying as she does the heart or central portion of the great Appalachian coal basin, contains a much larger area of *white sand oil territory* than her sister states of Pennsylvania, Ohio and Kentucky.

The year 1891 marked the maximum production (33,009,-236 barrels) of the Pennsylvania field, 32 years after the industry began, with the completion of the famous Drake well, and from that time (1892) forward the decline in Pennsylvania oil production has been rapid and almost continuous, so that in 1902, the pipe line runs from both the Pennsylvania and New York fields foot up only 13,183,610 barrels, or 329,735 barrels less than the West Virginia production, (13,513,345,) for that year.

The Future of West Virginia's Oil Production.

It is hardly possible that West Virginia's annual production can ever exceed that of 1900, (16,195,675 barrels,) and the probabilities are that from this figure the gradual decline of the last 3 years will continue, since it is almost certain that the largest and richest pools of oil in the State have been discovered. There is some compensation, however, connected with the unpleasant fact of waning production, and that is, the price of petroleum is almost certain to advance with the diminishing supply, and hence it is possible that when the quantity produced has decreased to only one-fourth of what it is now, the price received then may be equivalent to that obtained now for the greater quantity.

Statistics of Production in Pennsylvania.

The Statistics of Oil Production in our sister state of Pennsylvania, which are here given, constitute the strongest

evidence of the limited supply of petroleum, and are of themselves the most convincing argument that the stores of these precious hydro-carbons cannot last indefinitely. They read as follows according to Mr. Oliphant in Mineral Resources for the U. S. Geological survey:

	Barrels*
1859	2,000
1860	500,000
1861	2,113,609
1862	3,056,690
1863	2,611,309
1864	2,116,109
1865	2,497,700
1866	3,597,700
1867	3,347,300
1868	3,646,117
1869	4,215,000
1870	5,260,745
1871	5,205,234
1872	5,293,194
1873	9,893,786
1874	10,926,945
1875	8,787,514
1876	8,968,906
1877	13,135,475
1878	15,163,462
1879	19,685,176
1880	26,027,631
1881	27,376,509
1882	30,053,500
1883	23,128,389
1884	23,772,209
1885	20,776,041
1886	25,798,000
1887	22,356,193
1888	16,448,668
1889	21,487,435
1890	28,458,208
1891	33,009,236
1892	28,422,377
1893	20,314,513
1894	19,019,990
1895	19,114,390
1896	20,584,421

*These statistics also include the small oil production from the State of New York.

	Barrels.
1897	19,262,066
1898	15,232,702
1899	14,374,512
1900	14,559,127
1901	13,831,996
1902	13,183,610
1903	*12,527,000
Total	640,142,694

*Estimate by F. H. Oliphant.

Meaning of Fluctuation in Production.

The fluctuations shown in this production mark the rise and decline of great oil pools, like Bradford, Cherry Grove, Washington and McDonald, the last great pools discovered in Pennsylvania, which carried the production of that State to its maximum in 1891, from which it has steadily declined, and will in the nature of things continue so to do, with temporary spurts of increase from the discovery of new producing areas. The drill has now exploited the possible oil territory of Pennsylvania so thoroughly, however, that it is hardly probable any large areas of richly productive territory yet remain to be discovered that can materially increase, or even stay the present declining yield of petroleum in that State.

The same condition of affairs which these statistics reveal as the history of production in Pennsylvania, is now occurring in West Virginia and it is quite probable that the constant decline in the production of the West Virginia and Pennsylvania fields shown by these tables will continue indefinitely, unless indeed there may exist several good pools of oil (like that recently discovered near Milton, Cabell county,) southwest from the Little Kanawha river. Any such pools, however, could only retard the decline in the West Virginia fields, and accentuate their yield over those of New York and Pennsylvania.

CHAPTER II.

NATURAL GAS.

Along with this wonderful recent growth of the petroleum industry in West Virginia there has been a corresponding increase in the production of natural gas, so that this State now stands first of all the States of the Union in the production of this matchless fuel, and with proper care in husbanding this source of power and the prevention of needless waste it should last for another generation at least.

Nearly all the principal towns of the State west of the Alleghanies are now supplied with this fuel, while probably 200 million cubic feet daily pass out of the State, through the great 16 and 20 inch lines of the Hope, Philadelphia, Carnegie, Manufacturers Light and Heat, and other gas companies, to the cities of Pittsburg, Cleveland, Toledo, and intermediate points.

The hundreds of drilling wells, and thousands of pumping oil wells, and all of the pump stations for handling the oil produced, together with the water supply, and everything connected with the oil and gas industry, receive practically all of their power from the consumption of natural gas, so that the quantity thus burned must aggregate many millions (possibly 150-200 millions) of cubic feet daily. It is also practically the only fuel used in all of the glass factories of the State and many of the brick and pottery works, as well as electric power plants, city water works supply, etc.

A very wasteful use is that for the manufacture of carbon black in which probably 25 to 30 million cubic feet is daily consumed in Calhoun, Lewis, Doddridge, and other counties.

The entire quantity of natural gas daily used (generally in the most wasteful manner possible) within the State for every purpose will probably approximate 400 to 500 million cubic feet, while nearly half that amount is transported out of the

State, and probably as much more (200-250 million feet) is daily wasted through unplugged wells, leaking joints, and from producing oil wells. This estimate would make the quantity of natural gas daily coming to the surface in West Virginia, about one billion cubic feet, or the equivalent in heating power of one million bushels of coal—(40,000 tons) daily—14,600,000 tons annually or more than half of the State's annual production of coal.

All of this gas that is piped out of the State is sold at a rate of not less than 25 cents per 1,000 feet for domestic purposes, and 10 cents per 1,000 feet for manufacturing uses, while that taken to distant points, like Toledo, Cleveland, etc., is sold at 40 to 50 cents per 1,000 feet, hence if we value the gas produced in the State at only 10 cents per 1,000 feet, on the basis of one billion feet of daily production, it would amount to $100,000 per day, one-fourth of which is wasted without accomplishing any useful purpose whatever.

Quite recently there has been a general awakening to the enormity of this inexcusable waste of the best fuel in the world, and hence it is to be hoped that the State Legislature will, at its next session, take steps to prevent the same.

Methods of Transportation.

As is well known, natural gas exists in porous rocks under a pressure, proportioned to the depth of its reservoir below the surface of the valleys. This ratio of increase in pressure with depth is in about the same proportion as the weight of a column of water would increase with its length, so that at depths of 2,000 feet, 600 to 900 pounds of pressure to the square inch is developed when the gas in a new field is shut in, and for depths of 2,500 to 3,500 feet, pressures of 1,000 to 1,500 pounds are developed under like conditions.

This "rock pressure" as it is termed is sufficient of itself to transport the gas in large quantity by its own expansive energy from central West Virginia (Lewis county) to Toledo and Cleveland, distances of nearly 200 miles, so long as the "rock pressure" in the wells does not decrease below 500 to 600 pounds to the square inch. But in proportion as the gas is taken from any district, pool or field, the "rock pressure" in

that particular gas horizon will gradually decline, until its effective pressure to deliver gas at the end of a long pipe line would be lost entirely. To meet this contingency, the Philadelphia, Hope, and Carnegie Gas Cos. are installing large pumping stations in Wetzel county, where the gas flows from the wells to the pumps under a low pressure, and is then compressed by immense engines to about 600 pounds to the square inch before it enters the mains for transportation beyond the boundaries of the State.

The quantity of gas which any pipe line will transport, either under the natural pressure of the gas, or the artificial pressure created by pumps, depends upon many factors the relations of which have been investigated and skillfully worked out by Prof. S. W. Robinson, of the Ohio State University, and published in Vol. VI, of the Ohio Geological Survey. The diameter of the pipe, the length of the line, the pressure at the intake end, all enter into the calculation, while the number of angles or abrupt bends in the line all of which produce friction and retard the flow of gas are also large factors in the transportation of gas.

Mr. F. H. Oliphant has recently treated the subject of gas well measurement, and gas transportation quite thoroughly as based upon Prof. Robinson's formulae, and the following statements are quoted from his Report to the U. S. Geological Survey on the production of natural gas for 1902, pages 18-27:

Natural Gas Measurement.

"Originally the individual gas consumer was charged according to the size of the orifice used, through which at a known pressure, usually from 4 to 8 ounces to the square inch, a certain quantity of natural gas would pass. The consumer was allowed to use, if he so desired, all the gas that would pass through this orifice, for which a fixed price was paid. There was no inducement offered by the natural gas company to have the consumer use it in an economical manner.

Subsequently the meter was introduced, often to the general satisfaction of both of the parties interested.

A meter is a device for accurately measuring the quantity of any gas that passes through it. It usually consists of a series of diaphragms or bellows, operating valves automatically, the motive power being gas.

When the quantity of gas to be measured is large and delivered

under great pressure, a meter that will properly record the amount is weighty and expensive. To reduce the cost the proportional meter is in many instances used, in which a proportionately small amount is diverted to a tally meter controlled by a valve which equalizes the pressure. This tally meter is generally provided with a scale, which records the gross amount passed.

Natural gas is usually sold to the consumer by the cubic foot at a standard pressure of 4 ounces to the square inch, or 36 pounds to the square foot at a temperature of 60 degrees F. In many instances it is convenient to dispose of the gas at higher pressures, and then it is necessary to construct meters of proportional strength. The mean pressure of the atmosphere for the elevation at which most of the natural gas is sold is assumed to be 14.4 pounds to the square inch. In order to arrive at the correct number of feet when the gas is measured at a pressure greater than four ounces, the following formula will be found to be convenient. Usually no correction is made for change in temperature.

Formula for Measuring the Quantity of Natural Gas When Measured Above Normal Pressure.

$$Q=q\frac{p+h}{h+.25}$$

In which

Q is the cubic feet required.

q is the cubic feet shown by the meter.

p is the gauge pressure in pounds.

h is the atmospheric pressure of 14.4 pounds.

0.25 is 4-ounce pressure reduced to pounds.

By substituting the known values in the above it becomes

$$Q=q\,\frac{p+14.4}{14.65}$$

For example: Suppose the meter or "q" reads 1,000 cubic feet, and the pressure, "p" shows 32½ pounds to the square inch; required, to find the quantity of gas, then

$$Q=1{,}000\frac{32.5+14.4}{14.65}=3.2014\times 1{,}000=3{,}301.4$$

The result is therefore 3,201.4 cubic feet at the standard pressure of 4 ounces to the square inch. If the gas is measured at atmospheric pressure, then

$$Q=q\,\frac{p+h}{h}$$

MEASUREMENT OF NATURAL GAS FLOWING IN LARGE PIPE LINES AT HIGH PRESSURES.

This method depends upon the momentum of the flowing gas inside the gas main, because of which the quantity can be quite accurately determined by means of a device known as the Pitot tube, which consists of a small metal tube inserted in the pipe line, bent at a right angle and having its open end turned in the direction from which the gas is flowing. This tip communicates with one branch of a glass U-tube partly filled with some liquid (generally water.) The other branch of the U-tube is connected to another opening in the pipe line, the plane of which is at right angles to that of the opening into the Pitot tube and that of the flowing gas. By this means the branch connected to the Pitot tube will show a higher pressure than that connected to the pipe line, due to the momentum of the gas flowing against it. This difference of pressure will be shown by the difference in level of the liquid in the U-tube. Since this force is due to the velocity and density resulting in momentum of the gas passing, the rate of flow can be obtained and, by frequent observations, the velocity of the gas in a known area can be readily determined. The formula of the Pitot tube as applied to gas measurement has been very carefully determined by Prof. S. W. Robinson, whose report is published in the Geological Survey of Ohio, volume 6, pages 548-594.

The final formula is

$$Q=1,690d^2\sqrt{h\left(1+\frac{p}{15}\right)},$$

in which

Q=number of cubic feet of gas flowing in pipe line per hour.

d=diameter of pipe line in inches.

p=static pressure of gas in pounds.

h=difference in level of water in U-tube, measured in inches.

The formula was originally computed for gas flowing through the tube at a temperature of 40° F., but the temperature has been reduced to a standard temperature of 50° F. in the measurement by the formula as given above. It is for gas of 0.60 sp. gr. To apply to gas of any other gravity multiply the result by

$$\sqrt{\frac{0.6}{\text{Sp. gr. gas}}}.$$

Another method more generally applied for computing the approximate discharge of natural gas in lines of varying lengths, diameters, and pressures is presented in the following formula:

$$Q=42\sqrt{\frac{d^5(P^2-p^2)}{l}},$$

By considering the diameter to be 1 inch, and assigning a new value for $\sqrt{d^5}$ of $\sqrt{d^5}+\frac{d^3}{30}$ for diameters greater than 1 inch, as the value of the diameters increase more rapidly than $\sqrt{d^5}$, and working out separate values for the diameters of sizes in general use, which are designated as "a", the formula becomes

$$Q=42a\sqrt{\frac{P^2-p^2}{l}}.$$

Q=cubic feet per hour.
42=constant.
a=computed value in separate table for diameters,
P=gauge pressure+15 pounds at intake end of line.
p=gauge pressure+15 pounds at discharge end of line.
l=length of line in miles.

The following, the equivalents of "**a**" in the formula, are multipliers to be used for pipe lines larger than 1 inch in diameter:

¼-inch = .0317	2½-inch=10.37	8-inch= 198.0
½-inch = .1810	3-inch =16.50	10-inch= 350.0
¾-inch = .5012	4-inch =34.10	12-inch= 556.0
1-inch =1.0000	5-inch =60.00	16-inch=1160.0
1½-inch=2.9300	5⅝-inch=81.00	18-inch=1570.0
2-inch =5.9200	6-inch =95.00	

For pipes greater than 12 inches in diameter the measure is taken from the outside, and for pipes of ordinary thickness the corresponding inside diameters and multipliers are as follows:

Outside diameter of 15-inch pipe gives 14¼ inches inside diameter.....= 863
Outside diameter of 16-inch pipe gives 15¼ inches inside diameter.....=1025
Outside diameter of 18-inch pipe gives 17¼ inches inside diameter.....=1410
Outside diameter of 20-inch pipe gives 19¼ inches inside diameter.....=1860

For riveted or cast pipe with inside diamater of—

20 inches..=2055
24 inches..=3285
30 inches..=5830
36 inches..=9330

This table is interesting, as it shows the comparative value of different sized pipes. One 8-inch pipe has about 2.1 times the capacity of a 6-inch pipe, and one 36-inch pipe equals 4 1-2 pipes of 20-inch diameter. This formula applies to gas having a specific gravity of 0.6. To apply to gas of any other gravity multiply the result by a factor found by substituting the specific gravity of the gas measured in the following formula:

$\sqrt{\dfrac{0.6}{\text{sp. gr. gas.}}}$ atmospheric air being taken at unity.

For example: Suppose the pressure at the intake or high end of a line is 200 pounds, gauge pressure, and that at the discharge end is 20 pounds, the length of the line is 20 miles, the specific gravity is 0.6, air being 1, and the diameter of the pipes 8 inches. Then

$\sqrt{\dfrac{(200+15)^2-(20+15)^2}{20}}=\sqrt{2250}=47.45\times42=1993$, which is the discharge per hour for 1-inch pipe; but as the pipe considered is 8-inch, the multiplier to be used is 198; hence $198\times1993=394{,}614$ are the cubic feet discharged per hour under the above conditions. Suppose, however, that the specific gravity of the gas is 0.5, then by the previous formula $\sqrt{\frac{6}{5}}=\sqrt{1.2}=1.095$, and $1.095\times394{,}614=432{,}102$ per hour, or 10,370,448 cubic feet in 24 hours.

The correction for temperature is usually neglected.

COMPARATIVE CAPACITY OF PIPES OF DIFFERENT DIAMETERS CONVEYING THE SAME QUANTITY OF GAS APPLIED TO LINES IN WHICH A NUMBER OF DIFFERENT SIZES ARE USED.

The following table is based upon the fact that the length of pipes for the same quantity of gas varies as the 5.0835 power of their diameters. The value of the increasing or decreasing sizes can readily be appreciated by an inspection of the table.

It is particularly useful in securing the value of a series of different sizes of pipes in the same line by reducing the values of the several sizes to some one of the sizes in use. For example, on the horizontal line in the table a unit, say 1 foot or 1 mile of 8-inch pipe has the same value as 3.11 feet or miles of 10-inch, 7.80 feet or miles of 12-inch and 105 feet or miles of 20-inch.

When smaller sizes are used 1 foot or 1 mile of 8-inch pipe is equivalent to 0.2316 foot or mile of 6-inch pipe, etc.

Larger diameters, when compared, give the equivalent in an increased length and smaller diameters give a less length when compared with a diameter assumed to be 1.

Table showing the comparative value of different sizes of pipe compared to a unit read horizontally, looking above for the size of the pipe required, for comparison.

Size in inches	1	2	3	4	5	6	8	10	12	15¼	16	17¼	18	19¼	20
1	1	34	265	1,150	3,573	9,035	39,000	121,210	306,380	1,043,700	1,326,000	1,937,700	2,406,100	3,382,300	4,120,000
2	.0294	1	7.8	34	105	266	1,150	3,570	9,035	30,700	39,000	57,000	70,765	99,480	121.178
3	.0037	.128	1	4.34	13.45	34	147	457	1,150	3,940	5,004	7,312	9,040	12,760	15,550
4	—	.0295	.231	1	3.11	7.80	34	105	265	908	1,150	1,685	2,092	2,940	3,575
5	—	—	.0741	.3274	1	2.51	10.94	34	85.75	292	371	542.3	673.4	946.6	1,150
6	—	—	.0293	.1272	.3954	1	4.34	13.45	34	115.5	147	215	265	375	457
8	—	—	.0037	.0295	.0915	.2316	1	3.11	7.80	26.75	34	50	61.70	86.70	105
10	—	—	—	.0094	.0295	.0741	.3260	1	2.52	8.61	10.94	16	19.85	27.90	34
12	—	—	—	—	.0116	.0295	.1272	.3954	1	3.41	4.34	6.32	7.80	11.00	13.45
15¼	—	—	—	—	—	.0086	.0373	.1161	.2935	1	1.27	1.85	2.30	3.24	3.95
16	—	—	—	—	—	—	.0295	.0915	.2316	.7871	1	1.46	1.81	2.55	3.11
17¼	—	—	—	—	—	—	—	.0630	.1582	.5386	.6843	1	1.24	1.75	2.13
18	—	—	—	—	—	—	—	—	.1273	.4337	.5510	.8053	1	1.41	1.71
19¼	—	—	—	—	—	—	—	—	—	.3085	.3920	.5728	.7113	1	1.22
20	—	—	—	—	—	—	—	—	—	—	.3218	.4703	.5840	.8209	1

EXAMPLES SHOWING APPLICATION OF TABLE.

Suppose that a line is composed of 10-inch and 16-inch pipe, that there are 30 miles of the former and 20 miles of the latter, and that the pressure is 200 pounds at the end of the 10-inch section, next the source, and 25 pounds at the discharge end of the 16-inch section. After adding 15 pounds to each of the pressures to obtain the actual pressure, these become 215 and 40 pounds, respectively.

The formula is $Q=42a\sqrt{\frac{P^2-p^2}{l}}$ for 1-inch pipe, as previously determined. $\sqrt{P^2-p^2}=\sqrt{215^2-40^2}=\sqrt{44{,}625}=211.3$. For a 10-inch pipe the multiplier is $a=350$, as given in a previous table. The length of equivalent 10-inch pipe is now to be determined, so that it can be substituted in the formula. One foot or 1 mile of 10-inch pipe compares to 16-inch pipe as 1 to 10.94, and as there are 20 miles of 16-inch to be considered, $\frac{20.00}{10.94}=1.83$ miles of 16-inch equal 20 miles of 10-inch, $30+1.83=31.83$ miles of 10-inch line is equal to 30 miles of 10-inch and 20 miles of 16 inch line. This equivalent length remains the same for all variation of pressure at the intake and the outlet.

By substituting the determined quantities, the equation becomes $Q=42\sqrt{\frac{44625}{31.8}}\times 350$, $Q=\frac{42\times 211.3\times 350}{5.63}=551{,}700$ cubic feet per hour.

Suppose the pressure be increased to 400 pounds at the intake and 25 pounds at the outlet; then $\sqrt{415^2-40^2}=\sqrt{170{,}625}=413$. As compared with 211.3 this quantity would be 1.95 times 211.3, showing the increase in quantity to be almost directly as the pressure.

The proof of this illustration can be shown by substituting the equivalent distance for 16-inch pipe and the multiplier for the same instead of for 10-inch.

By referring to the table it will be found 16-inch comparee to 10-inch as 1 to .0915. As there are 30 miles of 10-inch lins to be converted to the equivalent of 16-inch, it becomes $\frac{30}{.0915}=328+20=348$ miles of 16-inch.

In the table for the equivalent of multipliers for larger diameters than 1 inch opposite 16 we find 1160; then, if the pressures remain 200 and 25 pounds, respectively, as before, $Q=42\sqrt{\frac{44625}{348}}\times 1160$, $Q=\frac{42\times 211.3\times 1160}{18.66}=551{,}690$ cubic

feet per hour, which is almost exactly the same quantity as obtained above.

Suppose, for example, that there were two 10-inch lines 30 miles long delivering into 20 miles of 16-inch line; to find the equivalent in miles of 16-inch line of equal capacity. In the table of multipliers for larger diameters than 1 inch, opposite 16-inch, 1160 will be found, and in the table for equivalent lengths on the 16-inch line, horizontally under 10, the number .0915 will be found, but as there are two 10-inch lines considered, $.0915 \times 2 = .1830$, which represents their equivalent compared to 16-inch pipe, and this divided into 30 miles=164 miles+20 miles=184 miles, then

$$Q=42\sqrt{\frac{44625}{184}}\times 1160. \quad Q=\frac{42\times 211.3\times 1160}{13.564}=759{,}000 \text{ cubic feet}$$

per hour.

The formula can not be so easily applied in reducing the two 10-inch lines to the value of the 16-inch line, because it is necessary to find the multiplier for the equivalent of two 10-inch lines, which by calculation is found to be 495. By examining the value of a 16-inch line on the 10-inch line in the table, it will be observed to be 10.94 for 1 mile of 16-inch line; but where two 10-inch lines are considered, then 10.94 divided by 2=5.47 miles, and 20 divided by 5.47=3.655+30 miles=33.655 miles of two 10-inch lines; then $Q=42\sqrt{\frac{44625}{33.655}}\times 495$, $Q=\frac{42\times 211.3\times 495}{5.79}=758{,}710$ cubic feet per hour, which is only a few feet less than the quantity ascertained by the other method.

VOLUME OR OUTPUT OF GAS WELLS MEASURED.

To ascertain the volume or output in cubic feet per hour of a gas well or an orifice, it is necessary to apply the Pitot tube to ascertain the momentum. This is found by holding the open end of a small pipe at right angles to the flow just below the end of the pipe or flush with it. At the other end of this small pipe is attached a syphon or U-gauge, in which water or mercury is used. If the pressure is over 5 pounds it is necessary to use an accurate steam gauge. The pipe connecting the tube is usually made of one-fourth-inch pipe, with an elbow and a short nipple attached, against the open end of which the gas flows. It should be held at one-fourth of the diameter from the outer edge. The formula from which the following tables were worked out was first applied to flowing gases by Prof. S. W. Robinson, of the Ohio State University, Columbus, Ohio, in which the specific gravity of the gas is taken at 0.6.

The number of cubic feet per hour that will pass out of a circular opening 1 inch in diameter, at pressures measured by a column of water or mercury or by a spring gauge, is given in the following tables. The third table contains multipliers for sizes of pipe less and greater than 1 inch.

Discharge of gas of 0.6 specific gravity from one inch opening corresponding to water pressure in inches.

Pressure in inches.	Cubic feet per hour.	Pressure in inches.	Cubic feet per hour.	Pressure in inches.	Cubic feet per hour.	Pressure in inches.	Cubic feet per hour.
0.10	495	0.90	1,485	3.50	2,928	10.00	4,950
.20	714	1.00	1,555	4.00	3,130	11.00	5,215
.30	857	1.25	1,738	4.50	3,321	12.00	5,422
.40	980	1.50	1,915	5.00	3,500	13.85	5,800
.50	1,106	1.75	2,070	6.00	3,834	20.77	7,110
.60	1,213	2.00	2,214	7.00	4,140	27.70	8,200
.70	1,310	2.50	2,475	8.00	4,428		
.80	1,401	3.00	2;712	9.00	4,694		

Discharge of gas of 0.6 specific gravity from 1-inch opening corresponding to pressure of mercury column and of gauge pressure.

Mercury pres-s're in inches	Pounds gauge pressure per square inch.	Cubic feet per hour	Mercury pressure in inches	Pounds gauge pressure per square inch.	Cubic feet per hour.	Mercury pressure in inches	Pounds gauge pressure per square inch.	Cubic feet per hour.
0.10	0.05	1,835	5.59	2.75	13.375	--------	14.00	28,495
.20	.10	2,590	6.10	3.00	14,175	--------	15.00	29,295
.30	.15	3,170	6.61	3.25	14,755	--------	16.00	30,045
.40	.20	3,655	7.11	3.50	15,320	--------	17.00	30,755
.50	.25	4,095	7.62	3.75	15,850	--------	18.00	31,415
.60	.30	4,490	8.13	4.00	16,370	--------	20.00	32,730
.70	.35	4,850	8.64	4.25	16,875	--------	22.00	33,470
.80	.40	5,180	9.15	4.50	17,360	--------	25.00	35,620
.90	.45	5,495	9.65	4.75	17,845	--------	30.00	37,945
1.02	.50	5,790	10.16	5.00	18,330	--------	35.00	40,040
1.52	.75	7,095	12.20	6.00	19,835	--------	40.00	41,945
2.03	1.00	8,195	--------	7.00	21,555	--------	45.00	43,605
2.54	1.25	9,165	--------	8.00	22,600	--------	50.00	45,080
3.05	1.50	10,030	--------	9.00	23,735	--------	60.00	47,380
3.56	1.75	10,830	--------	10.00	24,815	--------	75.00	50,975
4.07	2.00	11,550	--------	11.00	25,915	--------	90.00	54,350
4.57	2.25	12,275	--------	12.00	26,775	--------	100.00	55,705
5.08	2.50	12,950	--------	13.00	27,695	--------	110.00	57,055

Multipliers for pipe of other diameters than 1-inch.

Size of opening, diameter in inches.	Multiplier.	Size of opening, diameter in inches.	Multiplier.	Size of opening diameter in inches.	Multiplier.	Size of opening diameter in inches.	Multiplier.	Size of opening diameter in inches,	Multiplier.
$\frac{1}{16}$	0.0038	1	1.00	4	16.00	6	36.00	8	64,00
$\frac{1}{8}$	.0156	$1\frac{1}{2}$	2.25	$4\frac{1}{4}$	18.00	$6\frac{1}{4}$	39.00	$8\frac{1}{4}$	68.00
$\frac{1}{4}$	.0625	2	4.00	5	25.00	$6\frac{5}{8}$	43.90	9	81.00
$\frac{1}{2}$	.2500	$2\frac{1}{8}$	6.25	$5\frac{3}{16}$	26.90	7	49.00	10	100.00
$\frac{3}{4}$	.5625	3	9.00	$5\frac{5}{8}$	31.60	$7\frac{1}{4}$	52.50		

For any specific gravity other than 0.6, multiply by $\sqrt{\frac{.6}{\text{sp. gr. gas}}}$

For temperature of flowing gas when observed above 60°F. deduct 1 per cent for each 5°, and add a like amount for temperatures less than 60°F.

In practice these corrections are usually neglected and the comparison is made directly from the reading of the table.

The best natural-gas well is that one which at the highest pressure will discharge the greatest quantity of gas. This can be tested by closing in the pressure by a gate at a length of half a joint or more of pipe from the open end. A gauge connected by a small pipe back of the gate will record the increased pressure. The flow can thus be measured at an increasing back pressure by testing the open flow with a Pitot tube as the pressure inside the well is increased."

With the foregoing tables and examples as guides, it is an easy problem for any gas company to know the quantity of gas their lines will deliver, since their length, diameter, pressures at the intake, and discharge ends of the pipe lines, can be directly measured, and the proper figures substituted in the formulæ above given.

FUEL SAVING DEVICES.

That the methods commonly in use in West Virginia for utilizing the heat locked up in natural gas, are crude and wasteful in the extreme, goes without saying. Very little attention has been given either to the form of the burner, or to the necessity of securing the proper admixture of air in the production of either heat or light.

In the production of heat, no burner should be used that gives forth a bright flame, since unless the flame be blue, it is the best evidence that the burner is not supplying air in quantity sufficient for complete combustion, and hence much of the effective heating value of the gas is being wasted.

The burning of natural gas for illumination purposes, in open flambeaux or torches is such a wasteful method that some states, like Indiana, long ago prohibited this waste by statute.

Some form of incandescent burner, as the Wellsbach, or other similar device of refractory mantle, is the proper method

of securing the maximum of light at a minimum cost, or with the least consumption of gas, while the *gas engine* so far exceeds all other devices for economy in the production of power, that it looks almost like inexcusable extravagance to use natural gas for power through the production of steam.

Mr. F. H. Oliphant has published some figures on the economical use of natural gas for both power and light in his report for 1902, pages 17 and 18, which place this matter in a startling light as follows:

APPLICATION AND ECONOMY OF THE NATURAL-GAS ENGINE.

"The natural-gas engine has been extensively introduced throughout the gas belt. Its first application was made about ten years ago, when it was used in pumping petroleum wells. Afterwards, ranging from 5 to 500 horsepower, it was extensively introduced into manufacturing plants. It has successfully demonstrated its economy and reliability.

It is particularly applicable to the pumping of oil wells and to driving pipe-line pumps, owing to the large number of points that are often widely separated and are difficult to supply with other fuel. In pumping oil wells in the field it was the usual practice where steam was used to divide the wells into groups, placing a steam boiler as near the center as convenient and from it carrying steam lines to the several wells. It was usual to cover these lines with wooden boxes, but with the best appliances the condensation in these long lines was great, often only one or two wells could be pumped at one time and the work accomplished at the wells was not half the amount furnished by the boiler. Where wells were pumped by rod connections the loss was not so great. The gas engine has in very many instances replaced the steam engine and boiler. In some instances this has been done by removing the steam engine entirely, in others by the substitution of a gas cylinder for a steam cylinder, on the same engine bed. The dispensing with the troublesome boiler and the substitution of a much more economical engine has placed in the hands of the oil operator a much cheaper source of power not subject to the contingencies of the former method, with a great saving of labor and material, and also a great saving in the quantity of gas consumed, as the following table from actual tests, will indicate, not that all the gas engines pumping wells are fully as economical as shown in the following table. To offset this, however, it must be remembered that the ordinary oil pumping plant is a very extravagant combination so far as economy in the use of steam in concerned.

Comparison of fuel per indicated horsepower per hour for different types of engines.

Type of Engine.	Equivalent of Gas and Coal.	
	Gas.	Coal.
	Cubic feet.	Pounds.
Large natural-gas engine, highest type	9	0.9
Ordinary natural-gas engine	13	1.3
Triple expansion condensing steam engine	16	1.6
Double expansion condensing steam engine	20	2.0
Single cylinder and cut-off steam engine.............	40	4.0
Ordinary high pressure, without cut-off, steam engine.	80	8.0
Ordinary oil well pumping steam engine	130	13.0

Natural gas in connection with a mantle of alkaline earth (thoria, etc.) has produced the cheapest and best illuminant. Where natural gas can be had at 25 cents per 1,000 cubic feet and 50-candle power can be obtained from the consumption of 2½ cubic feet per hour with a mantle, the cost per candle power per hour is but .00125 of 1 cent.

In an ordinary Argand burner, with chimney, it will give about 12-candle power in consuming 5 to 6 cubic feet per hour. If consumed in an ordinary tip, 7 to 8 cubic feet per hour will yield 6-candle power. All natural gas has not the same illuminating value. In some districts it carries a small percentage of the heavier hydrocarbons, which add much to its illuminating properties.

The calorific value of natural gas is high, as 1,000 cubic feet in practice, under ordinary economical boilers, will evaporate 1,000 pounds of water from and at 212°F. This amount multiplied by 966, the number of British thermal units required to evaporate 1 pound of water, equals 966,000 British thermal units, which is one-third greater than the same amount of manufactured gas and double the value of enriched water gas.

One thousand cubic feet of natural gas will weigh approximately 45 to 48 pounds at 60°F., the same amount of dry air being 76.5 pounds in weight. Its composition closely approximates marsh gas, CH_4, with from 2 to 15 per cent. of nitrogen. The remaining 85 to 98 per cent. is almost pure marsh gas, viz., 75 per cent. of carbon and 25 per cent. of hydrogen. The gas in Northwestern Ohio and Indiana has 0.20 per cent. of sulphuretted hydrogen in its composition. Slightly less than 11 cubic feet of air is necessary for the complete combustion of 1 cubic foot of ordinary natural gas.

No other fuel, natural or artificial, has the value and convenience of natural gas. All other fuels require a large amount of labor to fit them for combustion, and most of them must be converted into gaseous form before they can be consumed. Natural gas, however, has reached that form, and is in condition to take to itself

the amount of oxygen necessary for combustion. The great natural reservoirs require only to be pierced by the drill, when the gas may be brought to the surface, where it is at once ready to be used as fuel and light or to become a direct source of power in the gas engine. No preparation is necessary for its combustion and no residue is left.

It is easily distributed in pipes to points of consumption many miles distant, and no known method for the distribution of power equals in economy that of the transportation of a gaseous fuel in pipes.''

The above tables prepared by Mr. Oliphant, show that the ordinary natural gas engine consumes only 13 feet of natural gas for the production of the same amount of power as 130 feet, or 10 times the quantity when burned and its heat utilized through the ordinary steam engine in vogue for drilling and pumping oil wells, as also for the general production of steam power with gas. This use of *ten* cubic feet of gas to accomplish the work that *one* would do when properly burned is not quite so wasteful as permitting all of the gas to escape into the air from unplugged wells, but it constitutes such an extravagant and unnecessary consumption of this precious fuel, as to be almost inexcusable from any standpoint. It is needless to state that the general adoption of the latest form of gas engine for power, and the mantle burner for light in West Virginia would eventuate in saving more than 100,000,000 cubic feet of natural gas daily, while securing even better results in the way of power and light.

The most wasteful of all forms of pretended utilization of natural gas is where the rock pressure of the gas is used instead of steam to operate a pumping plant for water with which to supply drilling or pumping wells, as has frequently been done in the immediate region of the oil and gas fields. That this and all other methods of wasteful use should be prohibited by statute is as desirable and necessary for the welfare of the State, and the prolongation of the life of our rich inheritance in this best of all fuels, as that wells should be plugged or shut in when not needed for the production of heat or light.

The State has probably lost more than $150,000,000 worth

of this fuel within the last decade alone through needless escape into the air without any pretense of utilization, while probably half as much more in value has been lost by the inexcusably wasteful methods of burning the gas for the production of light, heat and power. A priceless heritage has thus been ruthlessly destroyed, in spite of all the warnings that the State Geological Survey could give direct to the Legislature in official reports. It is not too late to save a remnant of this natural wealth for future use, provided the Legislature will act promptly at its next opportunity. The present delay has been inexcusable; to postpone the matter longer would be nothing short of criminal.

CHAPTER III.

THE GEOLOGY OF PETROLEUM AND NATURAL GAS.

Method of Occurrence.

Many people who are uninformed on the subject, imagine that both petroleum and natural gas occur in immense caverns, or hollow spaces within the earth's crust. Hence when one speaks of a "pool" of oil or gas the image of an underground lake or great cavity filled with nothing but liquid oil, or highly compressed gas, is called up to the minds of such persons as are unfamiliar with the oil industry. This is a great mistake, for with the exception of narrow fissures and joints which traverse all rocks, there are no large cavities or open spaces in any of the West Virginia oil producing strata. But all rocks are *porous,* even slate of the closest grain will hold some liquid in the minute and microscopic cavities which it, in common with all rocks, contains. Now the oil and gas *sands* are simply very *porous rocks* which contain not one great cavity, but millions upon millions of small or microscopic cavities, so that oil, gas, water, or all three together, it may be, (as at Sistersville,) occupy these numerous little spaces, and thus *saturate* the rock just as water does a piece of cloth or a sponge when dipped into the same. The larger these pores are, and the greater the volume they occupy in proportion to the volume of the rock mass, the greater will be the contained oil or gas supply, and this proportion in fairly good producing sands, usually varies between one-fifth and one-tenth, that is, a cubic foot of rock would hold, say, 6 to 12 pints of oil, and of course would contain an equal volume of cavities for water or gas should either of these substances be present, instead of oil.

Quantity of Petroleum to the Acre.

It is quite probable that the amount of oil obtainable from good producing sand in West Virginia will not average more than a gallon to the cubic foot, and also that the depth or thickness of "*pay streaks*" (porous sand saturated with oil) will not average more than five feet, and taking these factors as a basis, (there being 43,560 square feet in one acre,) we would get about 5,000 barrels of 42 gallons each as the total production of fairly good oil territory. Of course, if the sand reservoir should be exceptionally thick and of very great porosity, like a mere bed of loose gravel, this estimate may be much exceeded over limited areas, as it has been in Texas, where at Spindle Top, for instance, an area of less than 200 acres has already produced 15 to 20 million barrels of low grade oil. This prolific character of the reservoirs holding oil with an asphalt base instead of paraffine appears to be universal, since the same features characterize the oil deposits of Russia at Baku, Grozny, and elsewhere, and it appears to be due to a great thickness of producing sand, as well as to structural features which favor the accumulation of these very rich pools.

The amount named is a fair average, however, for what would be considered good producing territory in the white sand area of West Virginia, and may be regarded as approximately correct in figuring roughly the prospective values of developed properties. True, the conservative operator will always leave a safe margin on the right side of his valuation, in a business where there are so many contingencies, not only in varying thickness and porosity of the sand, but also in the price of his product which fluctuates within wide limits, and often within very short periods, but with the acreage estimate of production as a guide, investments may be made in developed oil properties quite as safely as in most other forms of property, and generally with a much greater margin of profit.

Not Possible to Obtain all the Oil Present.

It is impossible that all of the oil in any sand can be gotten out by the ordinary process of drilling wells into the same, and probably one-fourth of the actual amount present will remain in the rock, held there by capillary attraction, which

neither the accompanying gas, nor the attraction of gravity can overcome. The only manner in which this oil could be obtained would be to mine, crush and boil the sand, as was formerly done at Pechelbronn, Germany, from 1742 until 1880, where 4 to 5 per cent. of petroleum was produced from rock by such treatment.

The Presence of Salt Water Increases Proportion Obtained.

When *salt water* is found in connection with the oil as in the "Hundred Foot" district of Butler county, Penna., or the Sistersville field in West Virginia and Ohio, most operators consider that a much greater proportion of the oil can be secured than where the salt water is absent, since the water acts as a rinsing fluid to flush the petroleum out of the sand and bring it freely into the well. It is also claimed by the practical oil producers that the tendency of the rock to become clogged up with paraffine is much less when the petroleum is accompanied with salt water than when it is absent, so that for both of these reasons it is most probably true that the sand will yield up a greater proportion of its oil, when the latter is accompanied by salt water. Whether or not the increased yield will equal the increased cost of pumping the additional fluid (salt water) to the surface, is a question upon which we have as yet no reliable statistics.

Aids in Locating Oil and Gas Pools.

These questions have been very frequently asked by the petroleum seekers, "Can anything be done to limit the number of failures in the search for oil and gas?" "Are there any surface indications which can be relied upon to indicate the presence or absence of oil and gas in paying quantity at a depth of several hundred, or perhaps several thousand feet under ground?" "Cannot science with all her resources discover some means of saving a large portion of the hundreds of thousands of dollars that are annually lost in drilling unproductive wells?"

What answer does *geology* give to these questions which have been asked every day since Col. Drake drilled the first well for oil in 1859?

Geology answers that by careful attention to her precepts, *much* of the waste that characterized the first three decades of the search for petroleum can be avoided, but that it is beyond her powers to foretell absolutely as to whether any particular boring will yield either oil or gas in commercial quantity. The careful geologist can eliminate many of the factors of uncertainty, and thus limit the search to regions having a peculiar geological structure where experience has shown that the occurrence of oil and gas is most probable, but further than this, geology cannot go, and no skillful geologist has ever claimed otherwise.

The history of opinion upon this subject is of especial interest to the citizens of a State like West Virginia within whose boundaries so many millions of dollars have already been expended in the search for oil and gas, and where so many millions will be expended in the near future.

We may dismiss the attempts to locate oil and gas pools with the "divining rod," "magnetic devices," "spirit media," etc., all of which have found credulous victims in the past, but very few in recent years, with only this passing notice of their existence, and come down to the decade beginning with 1880. This decade will ever be memorable in the history of the Appalachian region, as marking the modern rise and culmination of natural gas production for use in the great manufacturing concerns of the Pittsburg region.

History of the Structural or Anticlinal Theory.

When the importance of natural gas to industrial affairs had been fully recognized, and the producers of oil had begun to turn their attention to the search for the new fuel, it was to be expected that some attention would be given to the study of its occurrence.

The first oil producer to undertake this study in a systematic way, was the late Mr. J. J. Vandergrift, of Pittsburg, Pa., then President of the Forest Oil Co., and the United Pipe Lines.

In the spring of 1883, Mr. Wm. A. Earseman, a veteran oil operator, who was then in the employ of the Anchor Oil Co., and who had noted the fact that many of the great gas wells of Pennsylvania were located along the lines where *anticlinal axes*

had been drawn on the maps of the State Geological Survey of Pennsylvania, secured Mr. Vandergrift's assent and financial support to undertake a geological investigation of the occurrence of natural gas. Mr. Earseman then began a correspondence with myself upon the subject, the result of which was an engagement in which the writer agreed to devote the month of June, 1883, to an investigation of the subject for Mr. Vandergrift. In this work I was often accompanied by Mr. Earseman, who communicated freely to me his ideas on the subject of anticlinals, though he did not then possess the necessary geological attainments to enable him to verify or disprove his suspicions. After visiting and studying the geological surroundings of all the great wells that had been struck in the Appalachian district, the conclusion was reached that the rock disturbance caused by anticlinal waves was the main and important factor in the occurrence of both petroleum and natural gas, and this announcement was made to Mr. Vandergrift in a written report at the close of June, 1883. During the next two years the theory was submitted to several practical tests in the successful location of the Grapeville, Washington, and other great gas pools. Having thus verified the hypothesis, it was duly formulated, and given to the public through the columns of "Science" in an article entitled "The Geology of Natural Gas," in the issue of that journal dated June 26th, 1885.

Since there have been many inquiries for this paper from those interested in petroleum, which it has been imposible to supply, the article in question is republished here. The statement in "Science" of June 26th, 1885, reads as follows:

The Geology of Natural Gas, by I. C. White.

"The recent introduction of natural gas into general use as a source of heat for industrial and domestic purposes has raised it from the rank of a mere curiosity to one of the earth's most valuable treasures.

"To the reader unacquainted with the change natural gas has effected in all industries where it can be obtained, the following quotation from an article in MacMillan's Magazine for January, written by Mr. Andrew Carnegie, the chief iron master of Pittsburg, will be a revelation: 'In the manufacture of glass, of which there is an im-

mense quantity made in Pittsburg. I am informed that gas is worth more than the cost of coal and its handling, because it improves the quality of the product. One firm in Pittsburg is already making plate glass of the largest size, equal to the best imported French glass, and is enabled to do so by this fuel. In the manufacture of iron, and especially in that of steel, the quality is also improved by the pure new fuel. In our steel rail mills we have not used a pound of coal, nor in our iron mills for nearly the same period. The change is a startling one. Where we formerly had 90 firemen at work in one boiler house, and were using 400 tons of coal per day, a visitor now walks along the long row of boilers and sees but one man in attendance. The house being whitewashed, not a sign of the dirty fuel of former days is to be seen; nor do the stacks emit smoke. In the Union iron mills our puddlers have whitewashed the coal bunkers belonging to their furnaces. Most of the principal iron and glass establishments in the city are today either using this gas as fuel or making preparations to do so. The cost of coal is not only saved, but the great cost of firing and handling it; while the repairs to boilers and grate-bars are much less.'

"This new fuel, which bids fair to replace coal almost entirely in many of our chief industrial centers, has not received that attention from the geologist which its importance demands. So far as the writer is aware, nothing has been published on the subject which would prove of any value to those engaged in prospecting for natural gas, and it is the existence of this blank in geological literature that has suggested the present article.

"Practically all of the large gas wells struck before 1882 were accidentally discovered in boring for oil; but when the great value of natural gas as fuel became generally recognized, an eager search began for it at Pittsburg, Wheeling, and many other manufacturing centers.

"The first explorers assumed that gas could be obtained at one point as well as at another, provided the earth be penetrated to a depth sufficiently great; and it has required the expenditure of several hundred thousand dollars in useless drilling to convince capitalists of this fallacy, which even yet obtains general credence among those not interested in successful gas companies.

"The writer's study of this subject began in June, 1883, when he was employed by Pittsburg parties to make a general investigation of the natural gas question with the special object of determining whether or not it was possible to predict the presence or absence of gas from geological structure. In the prosecution of this work I was aided by a sugestion from Mr. William A. Earseman, of Allegheny, Pennsylvania, an oil operator of many years' experience, who had noticed that the principal gas wells then known in western Pennsylvania were situated close to where anticlinal axes were drawn on the geological maps. From this he inferred there must be some connection between the gas wells and the anticlines. After visiting

all the great gas wells that had been struck in Western Pennsylvania and West Virginia, and carefully examining the geological surroundings of each, I found that every one of them was situated either directly on or near the crown of an anticlinal axis, while wells that had been bored in the synclines on either side furnished little or no gas, but in many cases large quantities of salt water. Further observation showed that the gas wells were confined to a narrow belt, only one-fourth to one mile wide, along the crests of the anticlinal folds. These facts seemed to connect gas territory unmistakably with the disturbance in the rocks caused by their upheaval into arches, but the crucial test was yet to be made in the actual location of good gas territory on this theory. During the last two years I have submitted it to all manner of tests, both in locating and condemning gas territory, and the general result has been to confirm the anticlinal theory beyond a reasonable doubt.

"But while we can state with confidence that all great gas wells are found on the anticlinal axes, the converse of this is not true, vis.: that great gas wells may be found on all anticlinals. In a theory of this kind, the limitations become quite as important as, or even more so than the theory itself; and hence I have given considerable thought to this side of the question, having formulated them into three or four general rules (which include practically all the limitations known to me, up to the present time, that should be placed on the statement that large gas wells may be obtained on anticlinal folds,) viz:

(a) "The arch in the rocks must be one of considerable magnitude.

(b) "A coarse or porous sandstone of considerable thickness or, if a fine grained rock, one that would have extensive fissures, and thus in either case rendered capable of acting as a reservoir for the gas, must underlie the surface at a depth of several hundred feet (500 to 2,500.)

(c) "Probably very few or none of the grand arches along the mountain ranges will be found holding gas in large quantity, since in such cases the disturbance of the stratification has been so profound that all the natural gas generated in the past would long ago have escaped into the air through fissures that traverse all the beds.

(d) "Another limitation might possibly be added, which would confine the areas where great gas flows may be obtained to those underlain by a considerable thickness of bituminous shale.

(e) "Very fair gas wells may also be obtained for a considerable distance down the slopes from the crests of the anticlinals, provided the dip be sufficiently rapid, and especially if it be irregular or interrupted with slight crumples. And even in regions where there are no well marked anticlinals if the dip be somewhat rapid and irregular, rather large gas wells may occasionally be found, if all other conditions are favorable.

"The reason why natural gas should collect under the arches of the rocks is sufficiently plain, from a consideration of its volatile

nature. Then, too, the extensive fissuring of the rock, which appears necessary to form a capacious reservoir for a large gas well, would take place most readily along the anticlinals where the tension in bending would be greatest.

"The geological horizon that furnishes the best gas reservoir in western Pennsylvania seems to be identical with the first Venango oil sand, and hense is one of the Catskill conglomerates. This is the gas rock at Murrysville, Tarentum, Washington, Wellsburg, and many other points. Some large gas wells have been obtained in the Sub-carboniferous sandstone (Pocono,) however, and others down in the third Venango oil sand. (Chemung.)

"In Ohio, gas flows of considerable size have been obtained deep down in the Cincinnati limestone, while in West Virginia they have been found in the Pottsville conglomerate; hence natural gas, like oil, has a wide range through the geological column, though it is a significant fact that it is most abundant above the black slates of the Devonian."

The views expressed in this paper were criticized by several geologists, but they were as warmly espoused and championed by others, so that the battle for the essential truth of the anti-clinal, or structural theory of the occurrence of oil and gas in commercial quantities, was soon won.

The Anticlinal or Structural Theory Not New.

This *structural theory* for the occurrence of petroleum and natural gas, arrived at independently by myself on the suggestion of Mr. Earseman, proved to be not new, but had long before been proposed by other geologists, though none of them with the exception of Andrews, and Minshall, had ever applied its principles in a practical way.

Dr. T. Sterry Hunt, the late eminent Canadian geologist, was probably the first to recognize the principles involved in the *anticlinal theory,* having published a paper on the subject in the *Canadian Naturalist,* as early as 1859, and another in the *American Journal of Science and Arts* for March, 1863.

The late Prof. E. B. Andrews, of Marietta, Ohio, also appears to have reached the same conclusions independently of Dr. Hunt, for in an article in the *American Journal of Science,* dated Marietta, May 20th, 1861, descriptive of the "Oil Break" of West Virginia, the influence of anticlinal folds on the occurrence of oil and gas is distinctly announced.

Mr. F. W. Minshall, of Marietta, Ohio, advocated the same

view as Andrews, concerning the West Virginia "Oil Break" in a series of articles published in the summer of 1881.

Prof. H. Hoefer, the distinguished geologist of Leoben, Austria, also appears to have formulated the same conclusions from a study of the Pennsylvania oil fields in 1876, and published the elements of the anticlinal theory in his book on "The Petroleum Industry of North America," pages 77-80, without any knowledge of the previous publications of Hunt and Andrews, while Newberry, Stevenson, and probably others had advocated the influence of *rock disturbance* as early as the '70's. Thus it appears that the theory had long ago been recognized and its essential elements published, but the practical oil men had never heard of it in a way to make any impression upon them, and the authors of the theory had made but slight attempts to apply its principles practically in the location and discovery of new oil or gas fields. This is the work which the writer has especially accomplished, and in the doing of it so enforced the lessons of geology upon the minds of the men engaged in the practical work of drilling for oil, that the acceptance of the structural theory is now universal among them, as well as among geologists. In this work the writer has been ably assisted by the late Dr. Edward Orton, State Geologist of Ohio, whose acute mind and facile pen have done much to popularize and enforce the geological claims of the anticlinal theory.

The geologists of Indiana have also contributed much to compel belief in the structural theory of oil and gas accumulation.

On the continent of Europe, and in Russia no other theory has any followers whatever, due largely to the work of Hœfer, Sjogren, and other geologists. No one can visit Baku, Grozny, Gallicia, and other oil fields of the old world, and see the great anticlinals which accompany every important deposit of petroleum, without concluding that *rock disturbance* is the important factor in such accumulations. It was the numerous oil pools along the crest and flanks of the great "Oil Break" anticlinal that extends from Burning Springs, Wirt county, to Eureka, Pleasants county, West Virginia, which first convinced

Prof. Andrews, in 1861, of the agency of *structure* in oil and gas accumulation. Guided by this principle, the writer pointed out and located all the great oil pools of West Virginia, for a Pittsburg syndicate in 1884 and 1885, long before the drill finally demonstrated the correctness of his conclusions. The detailed account of how one of these great pools was subsequently located and developed, 35 miles distant from any oil production at the time, has been told by the writer in an article entitled, "The Mannington Oil Field and the History of Its Development," published in the Bulletin of the Geological Society of America, Vol. 3, pages 187- 216, April 15th 1892, and the following quotations therefrom will give the reader a definite idea of the practical application of the principles embodied in the anticlinal theory in the discovery of an oil or gas pool:

"The Mannington oil field was developed by myself and associates, and as its location was made from purely scientific deductions illustrative of certain theories concerning oil and gas accumulation which I have taught for several years, a brief history of these theories and their application in the discovery of the Mannington field may not be without interest to geologists; and this must excuse much that is personal to myself in connection therewith.

"As is well known, it was formerly a popular saying among practical oil men that "Geology has never filled an oil tank;" and to such a low estate had oil geology fallen that a prominent producer of oil and gas, disgusted with geology and geologists, was once heard to remark that if he wanted to make sure of a dry hole he would employ a geologist to select the location. It has been my pleasant task during the last eight years to assist in removing this stigma from our profession, so that with the able and valuable assistance of Ohio's distinguished geologist, Professor Orton, Dr. Phinney, of Indiana, and others the battle against popular as well as scientific prejudice has been fought and won and this long standing reproach to geology in great part removed.

"The essential principles involved in the "anticlinal theory," have been very forcibly and graphically set forth by Professor Edward Orton, whose philosophic mind and skillful hand have grappled with and unraveled so many tangled threads of geologic history. Grasping at once the truth of the "anticlinal theory," he applied its principles in a striking and beautiful way to the explanation of the oil and gas deposits in Ohio. Expressed in his words, relief or structure is the essential element in the acumulation of large quantities of either oil or gas, for if the rocks lie nearly horizontal over a wide area we

find, when we bore through them, "a little oil, a little gas, a little water, a little of everything, and not much of anything;" while if the rock reservoirs be tilted considerably, so that the small quantities of oil, gas, and water in all sedimentary beds can rearrange themselves within the rocks in the order of their specific gravities, then and then only can commercial quantities of each accumulate, provided the reservoir and cover are good. The anticlinal waves which traverse the great Appalachian plateau westward from the Alleghanies and practically parallel to these mountains present just such relief as the theory requires in the New York, Pennsylvania, southern Ohio, and West Virginia oil and gas fields, while the more ancient flexures in northern Ohio and Indiana account for the large accumulations of oil and gas in the Trenton limestone of those states. The Florence (Colorado) and other oil fields in the far western states and territories have this tilted rock structure, and the same relief is plain in the Canadian oil and gas fields, according to Selwyn; while Tschernyschew, Sjogren, and other geologists who have studied the foreign oil fields, report an identical geological structure there.

"This theory, so simple and consonant with well known physical laws, as well as so harmonious with the facts of geology, was heartily welcomed by most of the oil and gas operators, and by nearly all geologists that have given any thought to the matter, as a satisfactory solution of the geologic problem connected with oil and gas accumulation. A few have attempted to relegate the great principle of relief to a subordinate position, but the facts have pointed so conclusively in the other direction that opposition has been silenced at least, whether convinced or otherwise.

"Guided by this theory I located in 1884 the important gas and oil field near Washington, Pennsylvania; also the Grapeville gas field along that great arch of the same name in Westmoreland county; and the Belleveron field on the Monongahela river. On the same theory I located and mapped out, for Mr. J. M. Guffey, the celebrated Taylortown oil field of Washington county, nine months before the drill demonstrated the truth of my conclusions. And right here on this Mannington-Mount Morris belt a derrick was built to bore for oil on one of my locations at Fairview more than five years before the drill finally proved that my location was immediately over one of the richest pools in the country, and before the drill had shown that there was any oil in this portion of West Virginia. These are only a few of the positive fruits of the theory to which we can point; the negative results in condemning immense areas of both oil and gas being even more important in preventing unnecessary expenditure and waste of capital where a search for either gas or oil would have certainly been in vain.

"My working hypothesis was that since the gas pressure is due to a column of water, and since this must be practically the same for any limited area where the rock lies at the same depth below sea level, the oil deposit in this particular rock must extend across the

country along the strike of the beds, in a pool comparable to the surface of a lake or a chain of small lakes, if the rock reservoir should not be equally porous everywhere along the strike. Hence, if my theory is true, it would only be necessary to follow the strike of any particular coal bed, limestone, or other stratum outcropping where the oil was actually developed in order to trace the course of the oil belt upon the surface, and thus to determine with approximate accuracy, many miles in advance of the drill, the location and width of such possible oil territory. Very fortunately for my purpose, two persistent coals, the Waynesburg and the Washington beds, cropped to the surface at Mount Morris, the first well finished there by Mr. E. M. Hukill, in October, 1886, starting immediately on top of the Waynesburg seam.

''My first work was to determine the tide elevation of these coal beds, especially the Waynesburg, with reference to oil, gas and salt water as developed by the Mount Morris borings. For this purpose one of my associates, Professor T. M. Jackson, then Professor of Civil Engineering at the West Virginia University, ran a line of levels from the Monongahela river (using a Baltimore and Ohio railway datum) out to the oil field, and made a complete survey and map of the twenty or more wells that had been drilled at that time (February, 1889) in and about the village of Mount Morris. He also obtained the elevations of the coal beds at every possible point. From the data thus acquired it was learned that wherever the Waynesburg coal had an elevation of 950 feet above tide, gas, and not oil was found, and that where it had dipped down below 870 feet, salt water was a certainty—in the Mount Morris region at least. As the Washington Coal is 155 feet above the Waynesburg bed, the gas and saltwater limits were found to be 1,105 and 1,025 feet above tide, respectively, when referred to the Washington bed as a datum line.

''With these facts in hand, it was only a question of correct identification, or tracing of coal beds, and a simple matter of leveling, in order to follow the strike of the surface rocks at least, for a hundred miles or more. But the query arose to me, ''Suppose the surface rocks do not lie parallel to the oil sand, then where will the oil belt be found?'' The interval between these coal beds and the oil sand might either thin away considerably or thicken up an equal amount in passing southward from Mount Morris. Of course, if either of these things should happen, the strike of the oil sand would not run with the strike of the surface rocks, but would gradually veer away from the latter either eastward or westward, depending upon whether the intervening measures should thicken up or thin away. To meet any such possible contingencies, the territory within which it was considered possible for oil to exist was gradually widened southward, and at Mannington extended eastward to where the Waynesburg coal had an elevation of 1,025 feet instead of 950 (the eastern limit of oil at Mount Morris,) and carried westward to where it had

an elevation of 800 instead of 870 feet (the western limit of oil at the north.)

"In following the strike line from Mount Morris to Mannington its direction was found to vary greatly. For the first five or six miles between Mount Morris and Dolls run the strike was about S. 30 degrees W.; but toward the head of Dolls run, the line turned rapidly westward, making a great curve or elbow and running westward past the village of Fairview, from which, with many curves and sinuosities, it crossed successively Plum run, Mods run and Buffalo creek at Mannington, on a general course of S. 45 degrees W., but varying from this 10 degrees to 15 degrees either way in certain localities. The strike line carried on southward from Mannington passed into Harrison county through the villages of Pleasantville and Grangeville.

"This course which I thus mapped out for the extension of the Mount Morris oil belt was so crooked and passed so much farther westward than the practical oil men had considered possible that my geological line, or hypothetical belt, furnished occasion for many jokes and gibes at my expense among the oil fraternity; and it was with the greatest difficulty and only by liberal gifts of supposed oil territory that I could induce any of them to risk their money on a purely geological theory. Finally, however, a contract to drill a test well in the vicinity of Mannington was entered into in the spring of 1889 with Mr. A. J. Montgomery, of Washington, Pennsylvania, a gentleman who had given considerable thought to geology. As this was to be a crucial test of my theory, the proper location for the test, 20 miles distant from any producing oil well, gave me no little concern, since if the well should prove a failure, oil geology would receive a fatal blow, in the eyes of practical oil men, while if successful their confidence in geology would be greatly increased and strengthened.

"The problem I had to solve was, whether the interval between the surface rocks and the oil sand would remain the same as at Mount Morris, or whether it would either thicken or thin; since, upon my theory, if I made a location at Mannington where the Waynesburg coal had an elevation of 900 feet above tide, and the interval from it to the oil sand remained the same (1,625 feet) as at Mount Morris, then if the oil rock proved open and porous a fair oil well should be found; while if, on the other hand, this interval should thin away to, say, 1,575 feet, then gas would be found, and if it should thicken up to 1,675 feet, salt water would be obtained, and this especially would be fatal to my theory, for the practical oil men were predicting that Mannington was several miles too far westward, and hence was in salt water territory. In the absence of any evidence bearing upon the subject, and rather in opposition to a general geological fact, viz.: that the sedimentary beds thin away rapidly westward from the Alleghanies, I made up my mind to take no chances on salt water in this, the first test well, and in finally determining the location, placed it where the Waynesburg coal had an altitude of 970 feet and the Washington about 1,125 feet. Such

a location at Mount Morris would have been in the gas belt by an elevation of 20 to 25 feet to spare.

"As the drill progressed it was found that the intervening rocks were thickening instead of thinning when compared with the Mount Morris column, and when the top of the oil sand ("Big Injun") was finally struck, the interval from it to the Waynesburg coal measured exactly 1,725 feet instead of 1,625, as at Mount Morris. Finally, on October 11, 1889, the drill penetrated the oil-bearing zone of this sand, and was immediately followed by a copious showing of oil, the result being that my theory was at once raised from the domain of conjecture to that of demonstrated fact. Thus a great victory was won for geology, since it taught the practical oil men once for all that they could not afford to disregard geological truths in their search for oil deposits.

"This thickening of the interval between the Waynesburg coal and the oil sand to the extent of 100 feet, in the distance of 25 miles from Mount Morris to Mannington, proved to have exactly the effect that I anticipated, i. e., it caused the oil belt to veer eastward until it gradually encroaches upon the territory occupied by the gas belt in the vicinity of Mount Morris; so that the western edge of the oil belt at Mannington is found where the Waynesburg coal has an altitude of 950 feet above tide, which is where the eastern edge occurs at Mount Morris, and the gas belt begins; and hence, had the first location at Mannington been made without taking into account a possible thickening, the well would have been too far westward, and a dry hole or salt water would have been the certain result. The amount of this eastward shifting of the strike of the oil sand compared with the strike of the surface rocks between Mount Morris and Mannington is something more than half a mile.

"Since this Mannington test well was drilled, about 200 others have been sunk along the belt, as previously defined by me, between Mount Morris and Mannington; and the correctness of my theoretical work has been demonstrated by the drill in opening up along this belt through Marion and Monongalia counties one of the largest and most valuable oil fields in the country. Fewer dry holes have been found along this belt than on any other oil belt known to me, not more than 5 per cent of the wells drilled within the defined limits proving totally dry.

"It is not claimed that this same chain of reasoning can be applied with lige successful results to the discovery and development of every great oil field that yet lies hidden below the surface of the Appalachian plateau, but it is believed that a correct understanding and appreciation of the principles involved and used in the discovery of the Mannington oil field cannot fail to prove most useful and helpful to both operator and geologist in limiting the expensive exploration of the drill to regions where the geological structure would indicate favorable locations for oil deposits. Of course no sedimentary bed can extend indefinitely in any direction, or even for

considerable distances, without undergoing a change in the character of its constituent elements. The individual particles of which it is composed must vary in size, and the cementing material, or lack of it, must be an ever-changing quantity. For these reasons any oil rock must be quite variable in porosity, and hence its productiveness cannot be a constant amount. Where the oil sand is a mere bed of coarse gravel or pebbles like that in the famous McDonald region of Washington county, Pennsylvania, or in the great Russian oil field, then the production of an oil well seems to be limited only by the size of the bore hole; while, on the contrary, the producing rock may become so close and compact within a few feet from a large producer as to be practically barren of oil. This fact was strikingly illustrated recently at McDonald, Pennsylvania, since at the very time the famous Mevey well number 1 was gushing oil at the rate of 15,000 barrels daily, another well was drilled through the same "Fifth sand," only 300 feet distant, and proved to be practically dry—the character of the producing rock having undergone a great change and become so close grained within such a short distance that it could not hold oil in paying quantity. If such changes as this can happen in the character of an oil rock reservoir within a few feet, much more would we expect such changes within a few miles; and thus it happens that although there appears to be a continuous deposit of oil in the Mount Morris sand, from the Pennsylvania line southward to Mannington, and for at least six miles beyond, yet the productive ness of the rock is not everywhere the same, because the character of the sand (reservoir) is not constant. This condition of affairs tends to concentrate the richest territory into pools of greater or less extent which are separated from each other by territory that is "spotted" or less productive.

When this tendency to change in the character of the sand or reservoir is carried so far as to render the rock impermeable to gas, oil or water for a considerable distance, then any oil belt must come to an end, and we need not expect it to set in again on the same strike of the rocks (though that is possible,) but rather when the stratum becomes again productive it will be found at a lower or higher level and on a different strike line, so that in this way we may have several parallel belts of oil in the same stratum, and occupying different levels with reference to their tidal elevation. Thus, there are numerous productive belts of the old Third Venango oil sand from Titusville, where it lies several hundred feet above tide, down to the southwestern corner of Pennsylvania, where it is 2,000 feet below tide. Hence the principles illustrated in this paper have a local as well as a general application—local, to enable the operator to follow the course of the oil belt when discovered; and general, to enable him to limit his search for oil territory to the localities where the geological structure is favorable."

Effect of Mannington Experiment Upon Operators.

The successful outcome of the Mannington experiment converted most operators to a belief in the *structural theory* of oil and gas accumulation, and even the few who may still assert their unbelief in what they call the ''anticlinal theory,'' make use of its principles in all their petroleum ventures; for there are no prominent operators now who do not observe very closely the *dip* and *strike* of the strata, and many of them employ expert geologists, and engineers to gather data in the fields as a guide to successful operations.

Relation of West Virginia Oil and Gas Pools to Geological Structure.

Every gas and oil pool in West Virginia illustrates and demonstrates the truth of the *structural theory.* The Sistersville field occupies the crown of a broad, low anticlinal where the relief is not sufficient to permit the separation of the gas, oil and salt water, and hence we find them all three commingled until the Big Injun Sand which holds them dips down to a level where only salt water is found. At but one or two limited areas in that great field has gas unaccompanied with oil or salt water been found, and these were (as they should be) where the sand attained its highest elevation.

The great gas district which stretches across Monongalia, Marion, Harrison, eastern Doddridge, Lewis, Upshur, Gilmer, Braxton, Calhoun and Roane counties, lies along the eastern edge of the oil fields, and therefore where the rock is elevated by anticlinal folds, down the slopes of which to the west we find such remarkable oil deposits.

The wonderful gas district of Wetzel and Tyler counties lies along the crest of a prominent arch of the rocks which passing south-westward through Kingtown, crosses the South Fork of Big Fishing Creek through Owl's Head Knob, (the greatest gas region in the country), and continuing on south-westward across Piney Fork, below that village, passes into Tyler county, along the crest of which we find a great gas development extending past

Bredin to the "Big Moses" gas field on Indian creek, to which the Philadelphia Company of Pittsburg has laid 75 miles of 16-inch pipe line; while just east of this anticlinal down its southeastern slope lies the Piney Fork, Alva, Hardman, and other great oil deposits.

The string of oil pools along the crest and flanks of the famous "Oil Break" anticlinal from Burning Springs to Eureka, and northward into Ohio, repeats the same story in such a striking way that "he who runs may read," while the sudden termination of the oil pools south-west from this great arch, is a striking argument for the influence of *structure* in determining the occurrence of oil and gas in paying quantities.

Region Southwest From the Little Kanawha River.

Probably 300 wells have been drilled in that portion of the state between the Little Kanawha river and the Big Sandy at the Kentucky line, a distance of more than 100 miles, and yet, aside from a half dozen small oil wells in Roane county, doing from 5 to 10 barrels daily, and a few gas wells of moderate size, the only pools of either gas or oil of much commercial value, yet developed in all this long stretch of territory, are the gas pool developed by Mr. F. P. Grosscup at the head of Sandy creek in Roane county and the oil pool near Milton, in Cabell county. The fact that these two productive pools lie along the northwest slopes of the only prominent anticlinal arch which has yet been discovered in this entire region is quite suggestive and should lead the operator to make careful investigations of structural conditions in the broad area between the Ohio river, and where the rocks begin to rise rapidly along the slopes of the Milton and Sandy oil and gas pools, since in much of this region where so many unproductive wells have been drilled, the rocks appear to be practically horizontal. It is true, the untested region is large, and it may contain several good oil and gas pools, but its lack of prominent anticlinals, and other structural features associated with the productive territory north from the Little Kanawha river, together with the negative results obtained

in the drilling of these 300 test wells give but little encouragement to the operator.

Necessary Conditions for the Existence of Oil or Gas in Underlying Strata.

The surface indications for the presence of oil or gas in any region are, then, the existence of well marked anticlinal waves, or what leads to the same results (viz., the accumulation of oil or gas in pools of merchantable value), the presence of rapid and irregular dips, giving rise to the *terrace* or warped structure of the strata. Of course these must be supplemented by the presence of porous reservoirs at a depth sufficiently great to prevent the escape of oil and gas to the surface in any considerable quantity.

Effect of Oil and Gas Escaping to the Surface.

Where such an escape does take place, we get as a result heavy lubricating oils, as in the ''shallow sand'' district near Petroleum, Ritchie county, in which case the overlying rocks are mostly porous sandstones, and evidently much fractured by the nearness of the great Burning Springs—Eureka uplift.

Effect of Rock Fissures Upon Oil and Gas Deposits.

When this fracturing of the strata has proceeded still further and opened out wide fissures (1 to 5 feet), as at ''Ritchie Mine'' on McFarland's Run, Ritchie county, W. Va., extending downward through all the strata to and below the underlying oil sands, thus permitting the escape of large quantities of oil and gas, the subsequent evaporation, and oxidation of the residual products left filling such fissures, have resulted in converting them into an asphaltic substance, resembling coal in appearance, named Grahamite, in the case of the Ritchie Mine deposit. That this was the origin of Grahamite, Albertite, Uintaite, or Gilsonite, is certain, since recent drilling near the Ritchie Mine in West Virginia has revealed a productive oil sand (''Salt Sand'') at 1,500 feet below the valley, and what is most significant is the fact that only a little oil is found in the underlying sand until the wells are located from 500 to 800 feet distant from the fis-

sure, thus showing that the rock has been *drained* in the immediate vicinity of the latter.

When Fissures are Small and Through Shale the Oil is Unaffected.

When the fissures are mere joints and through close-grained beds like shale, the escape of gas and oil to the surface appears to be largely prevented by even an hundred feet or so of such rock material, since at Cairo, Ritchie county, an oil of 35 degrees gravity is produced by the Clark Oil Company from a sand which lies less than 100 feet below the bed of North Hughes River. At Deem's Ferry, on the South Fork of the same stream, an oil of 40 degrees to 42 degrees gravity is found at a depth of only 250 feeet, and the oil at the mouth of Island run has about the same gravity at a depth of 300 feet.

Mountain Regions.

In most mountain regions, the fracturing of the strata has been carried on to such an extent that all the available stores of gas and oil that may once have existed in the beds have passed out of the original reservoirs through their defective covers, escaping into the air, and hence it is useless to drill for oil or gas to any ordinary depth in typical mountain regions.

It is barely possible that under a great thickness of close grained beds or shales the gas and petroleum originally contained in rock reservoirs so situated may still be imprisoned. No borings in mountain regions have been sunk to a depth sufficiently great (4,000-5,000 feet) to test the truth of this supposition.

The escape of the gas and all easily volatilized elements of the oil would render any remaining product so thick and viscous as to be unavailable except through mining operations as in the case of all asphaltic deposits which are only the residua of evaporated pools of petroleum. The great asphalt deposit at Trinidad is not in the crater of an extinct volcano as some geologists have stated, but is simply the asphaltic constituents of a great pool of petroleum comparable to Beaumont, Tex., or

Baku, Russia, where the cover has been eroded and the volatile constituents of the oil have escaped.

The Significance of Degree Lines.

It has long been a favorite method with many operators for oil or gas to follow some particular degree lines as a basis for further developments after the first paying oil or gas well is obtained in any region. S. 45 degrees W. or N. 45 degrees E. is a favorite line with many, while 22½ degrees, 30 degrees and 35 degrees as well as other figures have had their adherents. That a considerable measure of success has attended the observance of such lines is a well attested fact and the explanation is not difficult. Such lines are approximately parallel, and sometimes coincident for several miles with the *strike* of the strata, or in other words the direction in which the oil or gas rock lies approximately *level,* which is, of course, in most cases on a line parallel with *anticlinal axes* or other *structural* features of the region, and the structural theory of oil and gas teaches that in any particular pool the rock which contains the oil or gas, is likely to be saturated with the same as far as it remains porous and occupies the same level. Hence as these lines of *strike* or no dip are approximately parallel to the Alleghany mountains, (which extend N. E. and S. W. at angles of 30 degrees to 45 degrees,) any degree line approaching these figures must run some distance along an oil pool of considerable breadth before passing to either side of the same, and thus a degree line is valuable in searching for oil. For example a 45 degree line from Mt. Morris, Pa., S. W. to Mannington, W. Va., will define a large area of the *Big Injun Sand* oil territory between the two points and a similar line Northeast from the original *Thomas well* on Flat Run, Marion county, will run for 10 miles or more through that great *Gordon Sand* pool to the front of developments in Monongalia county. In the former case the 45 degree line would first pass west of the oil belt; then across, and east of it; then back into, and with it to Mannington and beyond, while on the latter or Flat Run belt, the 45 degree line would be within oil territory at every point from the

Thomas well in Marion to the farthest to the northeast yet drilled in Monongalia. On the Campbell's Run belt, however, which lies 3 to 4 miles west from the Flat Run developments, a 45 degree line from the original *Stiles well,* to the northeast, would soon pass east of that belt and into the barren area between it and the Flat Run field, while a 35 degree line would pass through a productive oil belt nearly to or beyond the Pennsylvania State line.

Structural, or Strike Lines Safest to Follow.

The best plan, however, is to disregard the degree lines and follow the *strike* or *level lines* of the surface rocks, such as coal beds, limestones, or persistent sandstones, when neither of the other two classes of strata are available, since the oil sands although many hundreds, or even thousands of feet below the surface, are approximately parallel to the surface rocks, and rise when the latter rise, or dip when they descend; thus when the rocks are level, the oil sands are nearly so. This law holds true for all the area north from the Little Kanawha river, but when we pass southwest from that stream, and start southward the measures thicken so rapidly in that direction that while the surface beds may be *rising,* the oil sands many hundred feet below may lie flat, or even be dipping to the south, and this condition of affairs is possibly one of the causes why so few pools of oil or gas have yet been found southwest of the Little Kanawha region, since the *relief* which even a rapid rise of the surface beds to the southeast would indicate, may possibly be offset and overcome by this thickening of the beds below the surface, so that the regular oil sand formations have little or no relief, being approximately level, and hence according to the "anticlinal theory," may not be expected to hold oil or gas in paying quantity, except in areas of that region where these underlying sands have been warped up into folds or more rapid dips like those near Milton, and the headwaters of Sandy creek in Roane county.

Rock Pressure in Oil and Gas Wells.

When an oil or gas well is drilled and the casing valve

closed so that the product cannot escape into the air, a pressure is developed inside the pipe. This pressure which increases with the depth of the oil or gas reservoir below the surface in about the same proportion as would the pressure in a column of water to the same depth, is known as "*Rock pressure,*" and is always greatest when a pool of oil or gas is first opened. When the producing capacity or volume of a well is large, the total pressure which a well will develop when shut in, is attained in a few seconds, or a minute at most, the famous Morgan well of the South Penn Oil Co., six miles southwest from Mannington, having developed a pressure of 800 pounds to the square inch inside of a three-inch pipe almost instantly. Wells with such large volume mean very open and porous reservoirs from which the gas or oil can escape with great rapidity. But a well of small volume, if completely shut in, will gradually develop the same "rock pressure," though it may be several hours or even days in attaining it, as the one with large volume, provided, both produce from the same reservoir, and are situated in the same pool.

The volume or value of a gas well is always roughly estimated from the pressure developed per minute when shut in (called its "minute pressure") and its total or "rock pressure." The ingenious method of measuring accurately the capacity of any gas well in cubic feet of product, by means of the Pitot tube adapted and modified by Prof. Robinson, of the Ohio State University, as already described, has not been used until quite recently by the gas companies operating in West Virginia, so far as known to the writer, greatly to their loss and detriment.

Cause of Rock Pressure.

There has been much speculation as to the cause of "rock pressure" in gas and oil wells, and many (including the writer) have believed it was of artesian origin, that is, due to water which has invaded the same rock from its outcrop at the surface. Prof. Edward Orton, the eminent State Geologist of Ohio, who has contributed so much to elucidate the problems connected with petroleum and natural gas, once held this view, and

apparently demonstrated its truth for the *Trenton Limestone* gas of Ohio, since in nearly every case the observed pressures agreed with the calculated pressure, assuming it to be of artesian origin and taking the level of Lake Erie as the surface outcrop of the Trenton Limestone. Recently, however, Prof. Orton has made some observations while studying the gas fields of New York that could not be explained upon the artesian theory, since in this case the "rock pressure" was 1500 pounds to the square inch at a depth of many hundred feet less than the theory would require, hence it breaks down as an explanation for all cases of gas and oil pressures, even if it may be the true cause in many fields, like the Trenton Rock of Ohio, Indiana, etc. In such cases like that of New York we are forced back upon the "*expansion hypothesis,*" advocated long ago by Prof. Lesley, as the only theory that will explain the facts, and the same would appear to be the only theory consistent with the facts concerning the high pressures in the deep or Gordon group of oil sands in West Virginia, since nowhere in Monongalia, Marion, Wetzel, Marshall, Tyler, Doddridge or Harrison counties has any water* been found in this group, evidently because they are so deeply buried (2500-3500 feet) by overlying close grained beds that the surface waters have failed to percolate down to them, and hence in these cases there would be no water present in the oil sands to cause the artesian pressure. It is barely possible that the seeming agreement with the artesian pressure theory may be due to the long continued escape of small quantities of gas upward along small fissures and joints through the overlying strata until the pressure of expansion within the rock reservoir has been reduced to what we now find it on opening any new gas field. This appears to be Prof. Orton's explanation

*The only exception to this statement known is a single well of the Delmar Oil Co. on the Shaffer farm, southwest from Mannington, where some fresh water made its appearance in the Gordon sand, but here there is a possibility that it was due to a leak in the outer casings, or a rock fissure communicating with the upper beds which may thus have led the surface waters down to the oil sand after the well was drilled.

of the exceptional pressure found at a comparatively shallow depth in the New York field to which reference has been made. It is also possible that this may account for the apparent agreement between the pressures observed, and the calculated artesian pressures in many new gas fields, since if there should be a constant escape of gas from any pool, the rock pressure would decrease continually until the expansive force of the remaining gas just equals the resistance of its passage to the surface, and in the case of small fissures filled with water this pressure would evidently be practically the same as the weight of a column of water extending from the outcrop level of the gas reservoir. rock down to its level in the gas pool.

Reservoir Gas and Shale Gas.

Dr. Orton makes a distinction between what he terms *reservoir* gas, and *shale* gas, the former including all *sand* or *limestone* strata, and the latter *shale* beds, which are mostly black. The pressure in *shale* gas is usually low and the volume small, the wells at Erie, Pa., and near Louisville, Ky., being examples of the same. So far as yet developed the West Virginia gas horizons all belong under the first or *reservoir* type, unless indeed we should include under the *shale* series, that found in the coal beds and in the deep boring near Huntington. Several examples are known in West Virginia as well as Pennsylvania, where valuable flows of gas have been obtained from coal beds. One of these was struck at Hundred, Wetzel county, W. Va., in 1886, by Messrs. Gibson and Giles, in the Pittsburg coal, at 700 feet in depth. Enough gas was found therein according to Mr. Gibson, with which to finish drilling the well through the Gordon sand, and it still furnishes a portion of the supply for the village.

Volume and Maximum Rock Pressure in Gas Wells.

Many of the great gas wells of West Virginia from the deep or *Gordon sand group* have never been tested for rock pressures when the pools in which they are situated were first opened, and hence we do not know exactly how great this pressure may be in the regions where these sands lie deepest.

The Thomas Cunningham No. 1, of the South Penn Oil Company in Wetzel county, was one of the very large wells in the Gordon group, and on July 1st, 1898, after it had been completed nearly a year, and had blown into the air several months before it was possible to shut it in, the rock pressure was still 1,200 pounds to the square inch.

The W. J. McCoy well in Greene district, Wetzel county, is also another very large well drilled by the same company. Mr. Wm. S. Edwards of Mannington, formerly Superintendent of the South Penn Oil Co., reports that the McCoy gas well showed a pressure of 1,075 pounds in one minute in 5 3-16-inch casing, which was the limit of the test. This well has a depth of about 2,800 feet, and the Cunningham the same, as both produce from the *"Stray"* immediately above what is called the *"Gordon sand"* in Wetzel.

The Abe Shriver well No. 1 in Battelle district, Monongalia county, drilled by the South Penn Oil Co., gave a *rock pressure* of 1,200 pounds (the limit of the gauge) on a one-minute test in 3-inch tubing. The Pittsburg coal was struck at 780 feet in this well, and the gas in the Gordon, or Flat Run sand at 3,007 feet.

Mr. John Worthington, of the South Penn Co., believes that the largest gas well both in volume and rock pressure ever discovered in West Virginia or any other state, is the E. C. Morgan well No. 1, drilled by the South Penn Co., six miles southwest from Mannington, Marion county. The top of the gas sand in the Morgan well was struck at 3,052 feet, the *Pittsburg coal* having been passed at 890 feet, thus giving the same interval (2,162 feet) below the latter stratum as the *Gordon "Stray"* or *Campbell's Run oil sand* occupies on Campbell's Run, Marion county, Miracle Run, Highland, and other regions in Monongalia county, and hence this gas is possibly from the same horizon as the great wells in Wetzel county to the west, though the interval from the Pittsburg coal to the gas sand is 100 feet less in Wetzel than in the Morgan well. At about three feet in the sand at the Morgan well, or 3,055 feet from the

surface, the gas was struck, and so great was its pressure, that the drilling tools weighing several thousand pounds, were lifted from the bottom of the well, and blown above the top of the derrick, through $6\frac{5}{8}$-inch casing, more than 100 feet into the air, according to Mr. Worthington. The well defied all the usual methods of procedure in shutting in large gas wells, and only after three months of uninterrupted work, was it finally conquered by the ingenuity of Messrs. Edwards and Worthington, and the men whom they directed. The 3 inch tubing could not be inserted in the $6\frac{5}{8}$-inch casing in the customary manner, but required the pull of "block and tackle" to force it into the well. Then when the proper depth (2270 feet) had been reached, where it was decided to set the rubber packer, it would not "take hold," and on withdrawing the tubing no *rubber* was visible, the fine sand and pebbles having been blown by the gas against it with such force as to destroy the rubber entirely and blow its material out as dust. This occurred several times, until Messrs. Edwards and Worthington decided to wrap the "packer" with iron wire before inserting the same, which finally proved successful and the well was shut in. This is the well which gave a pressure of 800 pounds (the limit of the gauge) almost instantly, or within two or three seconds, according to Mr. Edwards. The well was completed on the 19th of August, 1893, and after supplying the towns of Fairmont and Grafton, 25 miles distant for four years, still showed a rock pressure at the well of 765 pounds, January 1, 1898, and of 550 pounds January 1, 1899. Its production through the open casing when first struck, must have been enormous, probably between 35 and 40 million cubic feet daily.

The greatest pressure recorded from this same sand was made in the Nineveh region of Greene county, Penna., where a gas well on the Michael Funk farm was shut in by Mr. John Worthington, and although of comparatively small volume, the *rock pressure* finally surpassed the limits of the gauge (1500 pounds to the square inch), and did not stop until it blew up the 2-inch pipe with which it was shut in, probably developing a pressure of 1600 to 1700 pounds to the square inch, since this

class of pipe is supposed to be tested to 2,000 pounds before it leaves the factory.

It is quite probable that the total *rock pressure* in these deep sands (*Campbell's Run, Flat Run, 4th, 5th and 6th*) of West Virginia would exceed 1500 pounds to the square inch in the deepest portions of the field, if shut in and packed down to the top of each stratum in question.

A curious fact was discovered at the Alonzo Edwards well No. 1, near Wadestown, Monongalia county, West Va. This well was drilled by the Battelle Oil Company, and considerable gas was developed in the *Gantz Sand* horizon at 2770 feet, as well as in the *"Fifty-Foot"* Sand at 2840 feet, and a still larger flow was found in the *5th* or *McDonald Sand* at 3115 feet, the hole being completed at 3300 feet. The *Gantz* and *"Fifty-Foot"* sands constituted one solid, coarse, pebbly rock, and in order to save all of the gas flows, the well was packed in the upper portion of this pebbly stratum. From the great depth of the well, it was expected that the *rock pressure* would rise until it exceeded 1,500 pounds to the square inch, but when shut in the gauge which began to register rapidly at first, very soon slowed up, and finally stopped at only 650 pounds. As the pressure did not rise sufficiently rapid to correspond to the apparent volume of the gas when the gate valve was open, it was concluded that a large portion of the gas was being forced into the porous *Gantz* and *"Fifty-Foot"* beds, and *stored* therein, the 650 pounds representing the pressure necessary to store in the pores of that rock all the surplus gas produced from the three horizons at that pressure. This *storing* process could not of course go on indefinitely, since the new reservoir would require additional pressure to force the gas further and further back into the rock, and the conclusion was reached that in time the *rock pressure* of the well would show a large increase, and that the gas being thus stored up in natural reservoirs would be available for future consumption. This conclusion was subsequently verified. The well was shut in early in 1898, and not opened again (as there was no consumption for it) until January, 1899, when it was opened up and turned into a two-inch gas line for use in drilling

oil wells. The pressure, though not measured, proved so great that the two-inch pipe was blown up in several places, and it was found necessary to place a "reducing" arrangement upon the well.

Mr. Glen T. Braden, General Manager of the South Penn Oil Co., reports that he had the same experience with a well in Marion county, W. Va., similarly packed several hundred feet above the gas producing horizon, and that after the well had been shut in for 30 days, its pressure rose more rapidly and went to a higher point when opened and again closed in, thus demonstrating that the gas was being forced into porous beds and stored there in such a manner as to be available for future use. These facts should give a hint to the gas companies concerning a cheap method of *storing* gas wells not needed in the lines, viz., to connect the same with partially exhausted wells, and thus prevent too high pressures in the pipe lines, and at the same time preserve for useful work this surplus gas which would otherwise be wasted into the air from safety valves, etc.

The *rock pressures* in the *Big Injun Sand* are less than those in the *Gordon group*, since the top of the *Big Injun* lies 800-900 feet above the top of the *Gordon*.

In the Mount Morris region of Pennsylvania, and the adjoining district of Monongalia county, West Virginia, the pressure was about 550 pounds to the square inch soon after the field was opened in 1886, while at Blacksville, 8 miles west, where the same sand lies about 100 feet lower, the *rock pressure* in the *Big Injun* was 600 pounds when the first well was drilled. At Mannington the *Big Injun Sand* gave a total of 550 pounds at the Blackshere gas well, the first one opened to that sand, while the Snoderly gas well in the *Pottsville conglomerate* ("Salt Sand,") 400 feet higher up in the geological scale, stopped at 380 pounds. At Harrisville, Ritchie county, the *rock pressure* in the Big Injun sand was 680 pounds in the first well drilled by the Keystone Co., as reported by its president, Dr. D. H. Courtney, while still higher pressures are reported for this sand from the western or Cairo region of Ritchie county.

Mr. W. K. Jacobs, Superintendent of the Cairo Oil Co.,

Cairo, W. Va., informs me that when he first came to the Cairo region, ('96), the *rock pressure* in the *Salt Sand* gas wells was about 600 pounds to the square inch, and 900 pounds in the "*Big Injun*" sand below, thus greatly exceeding the highest pressures observed for the same strata in the northern portion of the state.

The *rock pressure* in the "Salt Sand" or Pottsville series seldom exceeds 400-500 pounds, since it comes 200 to 300 feet above the *Big Injun* horizon. Probably the largest gas well in the state at the present time is one owned by the Hope Natural Gas Co. on the Jacob McConkey farm, Harrison county, which, according to Mr. Glen T. Braden, shows a *rock pressure* of 985 pounds in the Gordon sand, and has a volume of 26,000,000 feet daily when flowing into the air. This well is shut in and has never been utilized. The greatest rock pressure now recorded anywhere in the state, according to Mr. Braden, is in Lewis county, where a pressure of 1125 pounds is shown by a well on the J. S. Norris farm.

In a later chapter of this volume it is hoped to present a few letters and statements from the superintendents of the several gas companies operating in West Virginia with reference to the rock pressure, and volume of some of the remarkable gas wells in different portions of the state.

The very high rock pressure recorded in Wetzel and Tyler counties in 1898 and 1899 is now a thing of the past, since so much gas has been wasted there through oil wells, and other escapes that the great gas companies, like the Philadelphia, Hope, and Carnegie, have found it necessary to install immense pumping stations in that region in order to force the gas through their lines to the principal points of consumption as Pittsburg, Cleveland, etc. When these wells had a high rock pressure, they would deliver in Cleveland 40 million feet of gas daily, through the 180 miles of 16-inch pipe line that connects the latter city with the West Virginia gas fields.

CHAPTER IV.

OIL AND GAS WELL RECORDS.

Generalized Section of the Strata in West Virginia, Showing the Principal Oil and Gas Horizons.

In drilling for oil and gas in West Virginia the operators have penetrated the entire column of rocks from near the top of the *Permo-Carboniferous* beds down to the *Corniferous Limestone,* near the base of the Devonian, though not all in one region of the State.

The following generalized section of this column of rocks may be introduced here for comparison with the names of the oil sands, and as showing the geological horizons of the different beds between the highest exposed strata in the state, and the bottom of the deepest borings, (Corniferous Limestone). The section is supposed to start from the top of one of the highest knobs along the dividing ridge separating the streams which pass eastward through Monongalia county to the Monongahela river, from those which pass westward through Wetzel and Marshall counties to the Ohio river:

Dunkard Series, or Permian, No. XVI.

			Feet.
Sandstone, Shale and concealed	160	to	160
Limestone, *Windy Gap*	5	"	165
Shales and concealed with coaly blossom	55	"	220
Sandstone, massive, *Gilmore, "Efaw," "Pethtle,"* etc.	30	"	250
Concealed with *red shales,* sandstone and limestone	275	"	525
Coal, Nineveh, John Taylor, exposed over both Glover's Gap and Board Tree tunnels, B. & O. R. R.	1	"	526

Shales and sandstone	25	"	551
Limestone, Nineveh, (exposed at each end of Board Tree tunnel; B. & O. R. R.	10	"	561
Concealed, *red shales* and sandy beds	40	"	601
Sandstone, massive, *Fish creek*	25	"	626
Coal, Dunkard	1	"	627
Shales, limestone, and concealed, with a thin coal bed	20	"	647
Sandstone, massive	20	"	667
Coal, Jollytown	2	"	699
Limestone	5	"	674
Concealed, sandstone, and shale, some *red*	135	"	809
Massive sandstones, *Marietta,* and shales, sometimes containing a slaty coal and limestone	100	"	909
Coal, Washington, seen in hills around Mannington, Pine Grove, New Martinsville, Sistersville, West Union, Cairo, Ritchie Mines, Spencer, etc.	3′ to 5	"	913
Shales and sandstone, with often a thin limestone and coal bed	80	"	993
Coal, Waynesburg, "A"	0′ to 4	"	995
Shales and limestone	10′ to 20	"	1010
Sandstone, Waynesburg, "Bluff," Hurry Up," etc., of the drillers	60	"	1070
Shales, base of *Permo-Carboniferous*	10	"	1080

Monongahela Series, No. XV.

Waynesburg coal, mined at Cassville, Monongalia Co., Fairview, and near Downs in Marion Co., and from Long Run to near West Union in Doddridge Co.	0′ to 8	"	1084
Shales	10	"	1094
Sandstone, Gilboy, cuts of B. & O. R. R., just east of Mannington; makes cliffs along Ten Mile, at Brown's Mills, Harrison Co.	30	"	1124
Shales and limestones	60	"	1184
Sandstone, Uniontown, probably the "shallow oil sand" operated on the Carroll farm, by the			

Clark Oil Co., at Cairo, Ritchie Co., W. Va., and the highest known oil sand in the state ... 20 " 1204

Coal, Uniontown, ...0′ to 4 " 1206

Shales, limestone, and limy shales, very green about midway ....120 " 1326

Sewickley sandstone, sometimes massive, but often flaggy, with much limestone interstratified .... 30 " 1356

Sewickley coal, "Mapletown" of oil drillers, mined on Scott's and Robinson Runs, Monongalia Co., and along the Monongahela river from Worthington in Marion Co., to Gray's in Greene Co., Pa., being 4 to 6 feet thick, but thinning away to the southwest, as well as to the northeast; reported as 4 to 6 feet thick by drillers westward, across Monongalia, Marion, Wetzel and Marshall to the Ohio river, probably same as *Meigs creek coal* of Ohio ....4′ to 6 " 1361

Shales, limestone and sandstone .... 56 " 1417

Coal, Redstone, mined on Scott's and Robinson runs, Monongalia Co.; also east of Jarvisville and other points in Harrison Co.; also on Peck's Run, Upshur county; and Century Co.'s mines, Barbour Co.; sometimes (once near Jarvisville, and once on Pedlar's Run, Monongalia Co.,) mistaken by drillers for the Pittsburg coal below; thickness ....0′ to 6 " 1420

Shales and limestone, or sandstone .... 35 " 1455

Coal, Pittsburg, the great "key" rock of the Monongalia, Marion, Harrison, Doddridge, Wetzel and Marshall Co. oil and gas fields; mined around Fairmont, Clarksburg, Weston, Buckhannon, Troy, Glenville, Wheeling, Moundsville shaft, Hartford, Spillman, Raymond City, etc., etc.; absent along the "Oil Break" anticlinal between Burning Springs and Eureka, and from a large area in Tyler, Doddridge, Ritchie, Gilmer, Pleasants, Wood, Wirt, Jackson, Roane,

Clay, Calhoun, and other counties in the southwestern part of the state; thickness including "roof" coals .... 10 " 1465

Conemaugh Series, or Barren Measures, No. XIV.

Shales, thin limestones, sandstones and sandy beds .200 " 1665

Sandstone, Morgantown, "shallow oil" sand at mouth of Island Run, Ritchie Co., and at Deem's Ferry, below the California House, same county; also produced oil on Dunkard creek, Greene county, Pa., sometimes called *Little Dunkard sand;* may be same as *First Cow Run* sand, in the Old Cow Run development of Ohio; often pebbly, quarried halfway up the hillsides at Morgantown.. .. ..25 " 1690

Elk Lick coal, often absent ....0′ to 4 " 1692

Shales, limestones, sandstone and red beds .... 50 " 1742

Green Crinoidal Limestone, Ames ....0′ to 2 " 1743

Coal, Friendsville, mined at Burning Springs, Wirt Co. ....0′ to 2 " 1744

Red shales, bad *"cave"* and *"Big red"* of the oil drillers .... 50 " 1794

Blue and red shales and sandy limy beds, also "caving" at times ....170 " 1964

Mahoning Sandstone, Dunkard Oil Sand, often called the *"Cow Run" Sand* by the oil well drillers; crops out in great cliffs between Petroleum and Volcano, B. & O. R. R., also near California House, on South Fork of Hughes river, and at the Eureka Pumping station and other points along the Monongahela between Morgantown and Little Falls; sometimes double with a shale intervening; an important oil horizon at Burning Springs, and in Wood, Wirt, Pleasants, and Tyler counties; also near Moundsville in Marshall Co.; thickness ....50′ to 150 " 2064

Allegheny River Coal Series, No. XIII.

Upper Freeport Coal, mined at Austen and Tunnelton on B. & O. R. R. ....0′ to	8	"	2068
Limestone and Shales	20	"	2088
Freeport Sandstones, one of the "gas sands" of the drillers; produced some oil at Fairview, Marion Co., W. Va., in P. W. Yost well No. 1, and is probably the *2nd "Cow Run" sand of* the old Cow Run development of Ohio	130	"	2218
Shales, with *Upper, Middle and Lower Kittanning* coal beds	50	"	2268
Fire clays, shales, sandy beds, and sometimes a limestone, (*Ferriferous,*) near center	60	"	2328
Pottsville Conglomerate, No. XII.			
The "*Salt Sand*" of the drillers in West Va., consisting of three to four members, separated by shales, and sometimes containing thin coal beds; the *New River* and *Pocahontas coals* belong in these rocks; important oil and gas horizons at Burning Springs, Volcano, Steer creek, and other regions of the state; one of the upper members of this group also called the "gas sand" by drillers; thickness	200	"	2528

Mauch Chunk Red Shales, No. XI.

Lower Carboniferous.

A series of *red shales,* green sandstones, and impure limy beds, holding the *Maxton oil sand* in its middle, an important oil and gas horizon in Tyler, Pleasants, and Ritchie counties, and possibly identical with the *Cairo sand* of the latter county; a dark slate near base caves badly in long splinters, hence its name of "pencil cave"; the *red shale* thins away entirely westward in Ritchie, Tyler, Pleasants, Wood, Wirt, and all the counties along or near the Ohio river, thus letting the *Pottsville beds* above rest immediately upon the *Mountain* or

"Big Lime" below; thickness ....0′ to 300 " 2678

Mountain or Greenbrier Limestone, the *"Big Lime"* of the drillers; another "key" rock for the petroleum seekers, and almost always present; thickens southward to 1400 feet in Greenbrier, Summers, etc., on the southwestern boundary of the State; supposed to hold oil, in southeastern Ohio, and in the Milton field of Cabell Co., W. Va., but that may be a limy portion of the *"Keener" sand;* thickness in the oil regions ....80′ to 100 " 2768

Pocono Sandstone, No. X.

"Big Injun" Oil Sand.

Top member of this series, the *"Big Injun" oil sand* of the drillers, a hard and often fine-grained gray sandstone, with usually two, and occasionally, three or four open, coarse, and porous, sometimes pebbly layers, filled with oil, gas, or salt water, called *"pay" streaks* by the drillers; in Monongalia, Marion and eastern Wetzel counties often unbroken by slate from top to bottom, and usually 140 to 150 feet thick, with a *gas "pay"* at 15 to 20 feet in the rock; the *1st oil "pay"* at 60 to 75 feet; the *2nd* or main one at 80 to 90 feet; and often a *3rd,* at 100 to 110 feet below the top of the sand. In Tyler, Pleasants, Ritchie, and other counties, the uppermost 20 to 30 feet of the "Big Injun" of Monongalia, Marion and Wetzel, usually separated from the main body of the rock by from 5 to 15 feet of dark slate, is then called the *"Keener Sand,"* and becomes an important oil and gas zone in the counties mentioned, though in Monongalia, Marion and eastern Wetzel nothing but *gas* has ever been found at this horizon, the main body of the "Big Injun" oil of these counties occurring at 75 to 90 feet

below the top of the sand; entire thickness of *"Big Injun"* including *"Keener" sand* ....140′ to 150 " 2913

Dark sandy shales ....20′ to 40 " 2943

"Squaw" sand of drillers .... 20′ to 30 " 2968

Shales and sandy beds, holding near the middle of the interval, and about 1750 feet below the Pittsburg coal, the *Berea Grit,* a productive oil and gas sand, 25 to 30 feet thick, in Pleasants, Wood, Wirt, Ritchie, Calhoun, Brooke, Hancock, and Cabell counties, possibly identical with the *Gantz Sand;* thickness of entire interval ....380 " 3348

Catskill, No. IX, Top of Devonian Beds.

Black and *red shale* beds of the uppermost Devonian .... 20 " 3368

Gantz and "Fifty-Foot" Sands; in Monongalia and Marion often a coarse, pebbly solid body of rock without a break for 90 feet or more (the *"Second Sand"* or *"Hundred Foot"* of Butler Co., Pa.,) having a *gas "pay"* at 10 to 20 feet from top (*Gantz sand*), and another 30 to 50 feet lower ("Fifty-Foot"); has produced some oil southwest from Mannington, Marion Co., and a small quantity in the Cynthia Kent Well No. 1 of the South Penn Oil Co., in Battelle district, near Cross Roads, Monongalia county, at 1945 feet below the Pittsburg coal bed. In the Fink or Vadis field of Lewis county, several small wells have been discovered in this sand along with salt water as in Butler Co., Pa. It has also proven productive in western Harrison, on the Haymond and other farms. Thickness ....50′ to 100 " 3443

Red and Blue shales, sandy beds, and a well defined *sand* near center known to drillers under the name *"Thirty-Foot,"* which has produced

gas, but no oil yet so far as known in West Virginia. The *red* and blue shales "cave" in the deep drilling of Monongalia, Marion and eastern Wetzel, and must be cased off with a "liner" before drilling into the oil or gas bearing sands below; thickness ....180′ to 200 " 3633

Stray Sand, great gas horizon of Wetzel, and other counties, also frequently oil bearing, usually separated from the underlying sand by 10 to 20 feet of slate; thickness ....20′ to 40 " 3663

Campbell's Run Oil Sand, of Marion and Monongalia, probably called the *Gordon "Stray,"* in the Flat Run field to the east, where it is gas bearing; a splendid oil producer of flowing wells in western Marion, Monongalia Wetzel and Marshall counties; probably the true *"Gordon" sand* of Washington county, Pa.; thickness ....20′ to 40 " 3693

Dark slate and sandy shales ....20′ to 40 " 3723

"Gordon Sand," of the drillers, *Flat Run Sand,* the deep producing sand at Flat Run, Mannington, and Whetstone, in Marion to the southwest, and at the Highland, Harvey, Haught and Walker regions to the northeast in Monongalia, and at the Eddy and Wise farms near Cross Roads on the Campbell's run oil belt in Monongalia. The largest oil wells in the state, and the most productive have been found in this sand, which is probably the *4th Sand* just below the *Gordon,* of Washington county, Pa.; thickness ....20′ to 30 " 3748

Dark shales, or sandy beds ....30′ to 50 " 3788

McDonald, or *Fifth Oil Sand,* of the Washington and Allegheny county group, of Pennsylvania; the *oil sand* at Wolf Summit and Jarvisville, Harrison Co., and the *gas rock* around Weston, Clarksburg and other points; showing a little

oil on the Summers farm, Lewis county; produces *gas* on Edwards farm near Wadestown, Monongalia Co., and on Brown farm, Dunkard creek, near Worley P. O.; thickness ....2′ to 40 " 3809

Shales ....60′ to 80 " 3879

Bayard, Sixth Sand, produces gas on Core, Wright, McCord, and other farms near Mooresville, Monongalia Co., small oil wells, 5 to 10 barrels, on the Blair, Shriver and other farms near Worley P. O., on Dunkard creek along the West Virginia and Pennsylvania line and is the splendid producing sand recently found in the region of Fairview, Marion county, at 2410 feet below the Pittsburg coal. It is also the deep gas sand northeast of Downs; basal member of Catskill beds; thickness ....5′ to 25 " 3894

Chemung and Hamilton Beds, No. VIII.

Gray and dark shales with an occasional shell, or thin, hard, fine-grained sandy bed, containing two or more gas horizons along the line between Greene and Washington counties, Pa., in the upper half of these deposits, the Speechley, Bradford, Punxsutawney and other *sand* horizons of Pennsylvania; penetrated 2000 feet in the Boggs Run, Wheeling, deep well, and in the Forest Oil Co.'s deep well on the Wm. Bedell farm, near West Elizabeth, Pennsylvania, they were penetrated 3288 feet below the *Sixth* or *Bayard Sand,* and 5705 feet below the *Pittsburg coal,* without reaching the *Corniferous Limestone;* but in the Central City deep well, on Four Pole, near Huntington, at the southwest corner of the state, the *Corniferous Limestone* was struck at 2760 feet or only 3100 feet below the Pittsburg coal bed, and but 2130 feet below the top of the *"Mountain" limestone,* while the Bedell well near Elizabeth

passed 4530 feet below the same *limestone* horizon, stopping in the *Hamilton* shales, probably not more than 100 feet above the *Corniferous beds*, thus giving a thinning away between Elizabeth and Huntington of 2705 feet as measured from the *Pittsburg coal*, or 2500 feet if measured from the top of the *Mountain Limestone*. The bottom of the lowest sand struck in the Central City well, lies 849 feet above the *Corniferous Limestone*, while if we estimate this limestone at 100 feet below the bottom of the Elizabeth well, it would there lie 3385 feet below the *Sixth* or deepest oil sand, which gives a difference of 2,536 feet between the Elizabeth and Huntington wells, due to *thinning* of the *Chemung* and *Hamilton beds*, or practically the same as that obtained (2705′ and 2500′) when we take the *Pittsburg coal* o1 *Mountain limestone* as datum planes, so that the westward thinning is thus shown to be confined practically to the Chemung-Hamilton series. A mean of the two measurements oi these formations would give (849′+3385′)÷2= 2117′ for the thickness of these beds at the longitude of say, Parkersburg, but adding the ful Elizabeth thickness for the Monongalia anc Marion county region gives the following total from the top of the *Permo-Carboniferous* to the *Corniferous limestone* ....3385′+3894′=7279′

Mr. F. H. Oliphant has published a table of the succession of oil and gas sands or horizons in his report for 1902 on Natural Gas, pages 14 and 15, in which the interval of each sand below the Pitsburg coal is given for the Appalachian district. This table which is of much interest, and is the result of much comparative study by Mr. Oliphant, reads as follows:

Productive natural-gas horizons.

Geological equivalent.	Natural-gas horizons.	Locality where productive.	Approximate de'h b'l'w Pittsburg coal.
			Feet.
Conemaugh or Barren measures XIV.	Pittsburg sand, capping Pittsburg coal	West Virginia	0
	Connellsville sand	do	40
	Morgantown sand	do	80
	"Hurry up sand"	Southwest Pennsylvania and West Virginia.	325
	Mahoning or Dunkard sand	do	485
Allegheny or Lower productive XIII	Lower Freeport or second Cow Run sand.	Southeast Ohio, southwest Pennsylvania and West Virginia.	630
	Ferriferous limestone	Not productive	890
Pottsville XII	Tionesta, Homewood, or Johnson Run sand	Southeast Ohio, southwest Pennsylvania and West Virginia.	920
	Upper Conoquenessing or upper salt sand	do	970
	Lower Conoquenessing or middle salt sand.	do	1,050
	Sharon Conglomerate, Olean lower salt or Maxon sand.	Kansas and Indian Territory, southeast Ohio, southwest Pennsylvania, West Virginia and Eastern Kentucky.	1,130
Mauch Chunk XI	Mountain limestone	Not productive	1,2[illegible]5
	Keener sand, sandy limesto'e	Southeastern Ohio and West Virginia.	1,345
Pocono X	Big Injun, or Sub Olean sand	West Virginia, southwestern Pennsylvania, southeastern Ohio, and eastern Kentucky	1,375
	Squaw sand	do	1,465
Catskill IX or Upper Devonian.	Upper gas sand	Southwestern Pennsylvania	1,535
	Berea or Butler County gas sand.	Southwestern Pennsylvania, West Virginia, Ohio and Kentucky.	1,730
	Devonian or Ohio shales	Western N. York, northwestern Pennsylvania, northeastern Ohio, western K'tucky and southern Indiana.	1,760
	First sand or Gantz (100-foot sand.)	Western Pennsylvania, West Virginia and southwestern Ohio.	1,850
	50-foot sand	Western Pennsylvania and West Virginia,	1,905
	Second or 30-foot sand	do	2,010
	Gray, Stray, or Bowlder sand	do	2,070
	Third or Gordon sand	Western Pennsylvania, West Virginia, and southeastern Ohio.	2,130
	Stray third sand	Western Pennsylvania and West Virginia.	2,145
	Fourth sand	Southwestern Pennsylvania and West Virginia.	2,200
	Fifth sand	do	2,260
	Bayard sand	Southwestern Pennsylvania and northern W. Virginia.	2,420

Productive natural-gas horizons—Continued.

Geological equivalent.	Natural-gas horizons.	Locality where productive.	Approximate de'h bel'w Pittsburg coal.
			Feet.
Catskill IX or Upper Devonian.	Elizabeth or sixth sand	Southwestern Pennsylvania and northern West Virginia	2,590
	Warren first sand	Northwestern Pennsylvania	2,700
	Warren second sand	do	2,815
	Clarendon or Tiona sand	do	2,935
Lower Devonian VIII	Speechley sand	do	3,100
	Balltown or Cherry Grove s'd	Northwestern Pennsylvania and western New York.	3,300
	Sheffield or Cooper sand	do	3,415
	Bradford or Deer Lick sand	do	3,525
	Elk sand or Waugh and Porter sand.	do	3,750
	Kane sand	do	3.925
	Black shales bottom of Devonian.	Northwestern Kentucky and Southern Indiana.	5,325
	Hamilton limestone	Southwestern Ontario, Can.	5,330
	Corniferous	New York and southwestern Ontario, Canada.	5,625
	Oriskany sand	Southern Indiana, southern Ontario, central New York	5,660
Silurian	Guelph limestone	Southern Ontario, western New York.	5,700
	Niagara limestone	Southern Ontario, western New York and Indiana.	5,820
	Clinton limestone	Southeastern and cent'l Ohio and southeastern Ontario.	5,985
	Medina red sand	Southeastern Ontario, western New York, and Ohio.	6,085
	Medina upper white sand	Southeastern Ontario and western New York.	6,185
	Medina white sand	Central New York	6,240
	Trenton limestone, upper portion.	Ohio, Indiana and Kentucky	8,700
	Trenton limestone, lower portion.	Southeastern and central Ontario and northern central New York.	9,225
Cambro-Silurian	Calciferous and Potsdam sa'd	Southeastern Ontario and central New York.	
Cambrian	Quebec group, s'ds and shales	Alabama, Georgia and northwestern Newfoundland.	

These tables are, of course, only approximately correct for all of the intervals below the Corniferous limestone, and for those above, would hold good only in Western Pennsylvania and the adjoining portion of West Virginia.

The foregoing general section will serve to show the relations of the oil sands to the coal beds and other strata which crop to the surface in the different regions of the state. We shall now give a series of well records, beginning the list with some very deep borings made in the neighboring state of Pennsylvania.

The only well in the oil regions of Pennsylvania that has ever been drilled through the Devonian shales and into the Corniferous limestone is one on the west bank of the Allegheny river, 8 miles south from Franklin, Venango county, and is known as the Conway well, since it was drilled by the Conway Brothers of Philadelphia. It is located on the old Witherop farm, and the top of the well is 955 feet above tide, according to the late Mr. John F. Carll, who gives the following record in Report I-5, Second Geological Survey of Pennsylvania, page 185:

Conway Deep Well.

	Feet.		Feet.
Drive pipe	48	to	48
"Usual drilling"	224	"	272
SS., First sand	68	"	340
"Usual drilling" (cased at 342)	108	"	448
SS. Stray second (salt water & gas)	20	"	468
Shale	15	"	483
SS. Second sand, blue and shelly	20	"	503
Shale	87	"	590
SS. Third sand, no oil	5	"	595
Shale, blue, thin streak of red	750	"	1345
Gritty, shelly formation estimated	25	"	1370
Shale, blue	1180	"	2550
Shale red (some red shale 2550) say	10	"	2560
Shale, blue	155	"	2715
Shale, black (smell of oil) say	50	"	2765

Shale, blue "easy drilling"	235	"	3000
Shale, black "thin" (April, 1887)	15	"	3015
Shale and slate (October, 1888)	432	"	3447
Slate, black and occasional shells	233	"	3680
Slate, brown, muddy (smell of oil)	15	"	3695
Slate, black	27	"	3722
Slate, white	60	"	3782
Slate, black, some shells	50	"	3832
Slate, white	18	"	3850
Slate, brown, muddy	10	"	3860
Slate, black, sand	10	"	3870
Limestone, brown, "Corniferous"	10	"	3880

The "Venango Oil Sand Group" of Carll is seen at the top of the foregoing record, beginning at 272 feet and ending with the *Third* or *Fourth* sand at 595, the whole being 323 feet thick, and corresponding to the measures in West Virginia between the top of the *Gantz sand* and the bottom of the *Gordon*. The top member of the Venango oil sand group lies about 1800 feet below the *Pittsburg coal* horizon in this region of Pennsylvania, and if we add that interval to the record, it gives a measure of (3870′+1528′)=5398′ for the thickness of strata between the *Pittsburg coal* and the *Corniferous limestone* in the vicinity of Franklin. In the Wheatland deep well, just below Sharon, Mercer county, and about 40 miles west from Franklin, this same interval foots up only 4777 feet, or 621 feet less, while in the Wm. Bedell well, 12 miles southeast of Pittsburg, and 75 miles S. southeast from Sharon, the drill had not yet encountered the *Corniferous Limestone* at a depth of 5,705 feet below the *Pittsburg coal*, thus showing an increase in thickness of the Devonian beds southward as well as eastward.

The late John F. Carll, when in charge of the oil region work for the Second Geological Survey of Pennsylvania, had several records kept with great care in the central portion of the Butler county oil field, and the same were published in his Report I-3, pages 194 *et seq.* A few of these standard records will prove useful for comparison with the West Virginia oil sand series, and are here given for that purpose as follows:

Sutton Well No. 4.

On P. Sutton farm, Fairview township, Butler county, Pa., about two and one-fourth miles south 70° west of Petrolia. Well mouth above ocean in feet 1436.

	Feet.		Feet.
Conductor	9	to	9
Slate, alternating with sand shells, bluish	133	"	142
SS. dark gray	24	"	166
Slate and shale	6	"	172
Coal, "Coal"	1	"	173
Slate and shale, dark gray	49	"	222
Limestone, "Limestone"	..	"	222
Slate, dark gray	34	"	256
SS., gray	16	"	272
Slate, shale and sandy shells, dark	125	"	397
Limestone, "Ferrif. Limestone"	20	"	417
Slate and sand shells with some iron pyrites and trace of coal, dark	32	"	449
SS., "60-Foot Rock" top white, bottom	..	"	....
black	43	"	492
Slate and shale, bluish gray, bottom black	45	"	537
SS., grayish white, "20′ Rock"	18	"	555
Slate and shale, shelly, dark	52	"	607
SS., white 30′ / SS., gray 20′ / SS., white and soft 50′ / SS., white and close 40′ / SS., white and soft 43′ — **"Mountain Sand" ("Big Injun")**	**183**	**"**	**790**
Slate, shale and sand shells, dark on top, black on bottom	145	"	935
SS., hard and white	5	"	940
Slate, clean, bluish-gray	30	"	970
SS., shaly, gray	20	"	990
Shale, slaty, bluish-gray, with a gas vein at 1190′ in a thin shell of fine bluish SS.	260	"	1250
Shale, sandy with a few yellow pebbles, bluish	52	"	1302
Slate, shaly, purplish	34	"	1336
SS., pebbly 3′ / SS., gray 9′ / SS., slaty mixture 12′ / SS., gray and fine 12′ — **(Gantz) "Second Sand"**	36	"	1372
Slate and shale, dark	38	"	1410
SS., uniform, hard, white, "50′ Rock"	22	"	1432
Slate, blue	28	"	1460
SS., homogeneous, fine, white, "30′ Rock"	42	"	1502

Slate, shelly, blue	8	"	1510
SS., yellowish-gray, fine, "Bowlder"	14	"	1524
Slate, blue	6	"	1530
SS., gray, "Stray Third"	16	"	1546
SS., pebbly			
SS., white, "Third Sand"	20	"	1566
SS., gray and hard	..	"	....
Slate, shaly, dark blue	40	"	1606
SS., dark, "cloverseed" pebble, "Fourth Sand"	25	"	1631
SS., fine white (not through)	..	"	....
SS., good white pebble	..	"	....

Drilled dry. Cased at 643′. A very little salt water below the casing.

Gas at 1190′, half sufficient to fire the boiler with while drilling, but this gas was exhausted in three or four days. About the same amount of gas was found in the "Second sand." Very little oil in the "Third sand." The hole filled up 300′ or 400′ with oil from the top of the "Fourth sand," and flowed when drilled a few feet deeper. No Red Rock found in drilling. Best daily production, 40 barrels.

Dougherty Well No. 2.

Situated on the McCleary farm, Fairview township, Butler county, Pa., about one mile south 80° west of Petrolia, and one and a quarter miles north 60° east from Sutton well No. 4. Mouth of well 1,327 feet above ocean.

Conductor	10	to	10
SS., surface yellow	5	"	15
Slate, bluish	55	"	70
Limestone, thickness unknown "Limestone"	..	"	70
Slate, sandy, top blue, bottom gray and muddy	85	"	155
SS., gray	51	"	206
Coal, slaty, "Coal"	3	"	209
Sand shells, hard and blue,	10	"	219
Slate, dark	21	"	240
Limestone "Ferriferous Limestone"	20	"	260
Slate, soft, dark	20	"	280
SS., "60′ Rock," gritty, white	80	"	360
Slate, very dark	30	"	390
Shale, sandy, dark gray	50	"	440
SS., hard, white, with layers of black slate "20′ Rock"	24	"	464

Slate, black	8	"	472
SS., soft and gray on top, hard and white on bottom	83	"	555
Slate, dark, with gray sand shells	27	"	582
SS., top fine yellow, bottom soft and gray, "Mountain Sand" (Big Injun)	93	"	675
Slate, shelly, bluish	17	"	692
Slate and gray sand shells	108	"	800
Slate, bluish	125	"	925
Sand shells, gray	15	"	940
Slate, bluish	100	"	1040
Slate, purplish	80	"	1120
Slate, bluish	58	"	1178
SS., hard and bluish-gray 12′; SS., olive and gray 20′; SS., slaty 45′; SS., fine gray 10′ — "Second sand" and "50′ rock" (Hundred Foot)	87	"	1265
Red rock	1	"	1266
Sand shells and slate "30′ Rock"	48	"	1314
SS., hard and white on top, yellowish-gray on bottom, "Blue Monday"	16	"	1330
Red rock, "Big Red Rock"	12	"	1342
Slate, bluish	21	"	1363
SS., very fine and light gray "Bowlder"	10	"	1373
Slate, dark	12	"	1385
SS., fine, white, "Stray Third"	27	"	1412
Slate, dark	8	"	1420
SS., (about through) pebbly and white on top, fine and yellowish-gray at bottom	16	"	1436

Drilled dry. Cased the first time at 478′. Flood of salt water at 570′. Casing pulled and put in the second time to a depth of 610′, and found no water below this depth. A small amount of gas in the "Second sand." Oil in the "Third sand" at 1,423′. Average daily production, 15 barrels.

Evans Well No. 21.

On the Dougherty farm, Fairview township, Butler county, Pa., about four-fifths of a mile south 40° west of Petrolia, and about three-fourths of a mile south 40° east of the Dougherty well, No. 2. Well mouth above ocean, 1,393 feet.

	Feet.		Feet.
Conductor	18	to	18
Slate and shale with bluish-gray shells	162	"	180
Limestone, thickness unknown, "Limestone"	..	"	180
SS., very fine, dark	45	"	225

Shelly shale, gray	64	"	289
Coal, "Coal"	1	"	290
SS., very muddy, fine, gray	4	"	294
Slate and shells, gray, muddy	43	"	337
Limestone, "Ferriferous Limestone"	21	"	358
Slate, very dark	18	"	376
Coal, "Coal"	4	"	380
Slate, very dark	6	"	386
SS., top gray and close, bottom fine and dark, "60′ Rock"	66	"	452
Slate, dark	44	"	496
Slate, with dark sand shells	50	"	546
SS., gray	5	"	551
Slate, sandy, dark	35	"	586
SS., white, with trace of coal	2	"	588
Slate, sandy, dark	9	"	597
SS., gray, occasional partings of dark slate, ("Big Injun") "Mountain Sand"	148	"	745
Slate, fawn-color and bluish	20	"	765
Sand shells, gray, with partings of slate and shale	80	"	845
SS., flaggy, olive-gray	50	"	895
SS., white	35	"	930
Slate, sandy, dark	70	"	1000
Slate, more shelly, dark-gray	100	"	1100
Slate, muddy, dark	100	"	1200
Slate, sandy, dark	74	"	1274
SS., fine olive-gray, "Second Sand" (Gantz)	17	"	1291
Slate, dark	3	"	1294
SS., fine, with slate partings, "50′ Rock" olive-gray	54	"	1348
Red rock, sandy "30′ Rock"	13	"	1361
Slate, dark, with gray sand shells	36	"	1397
SS., hard, bluish-gray, "Blue Monday"	6	"	1403
Red rock, hard slate	27	"	1430
Slate, dark	29	"	1459
SS., hard, olive-gray, "Bowlder"	10	"	1469
Slate, dark	12	"	1481
SS., white, "Stray Third"	25	"	1506
Slate, dark	7	"	1513
SS., pebbly, coarse, gray "Third Sand"	15	"	1528
Slate, shelly, purplish, trace red rock at 1565′	58	"	1586
SS., pebbly, coarse, white, "Fourth Sand"	22	"	1608
Slate, very dark	8	"	1616

Drilled dry. Cased at 705′, and found no water below casing. A little gas at 1,120′. Oil at 1519′, and no increase of oil in

the "Fourth sand." Torpedoed, but no apparent increase of oil. Pumped about one and one-half barrels of oil per day. Torpedoed a second time, and after that said to be averaging 10 barrels per day.

Hazelwood Well No. 21.

Owned by Hazelwood Oil Company, on the H. P. Shakely farm, Fairview township, Butler county, Pa., about one-half mile south 35° east of Petrolia, and four-fifths of a mile north 75° east of Evans well, No. 21. Well mouth above ocean, 1,298 feet.

	Feet.		Feet.
Conductor	16	to	16
Shells, soft, shaly, gray, muddy	110	"	126
Shells, slaty, gray	30	"	156
Slate, hard, sandy, bluish-gray	44	"	200
Coal, "Coal"	1	"	201
Slate, gray and muddy	44	"	245
Limestone, "Ferriferous Limestone"	20	"	265
Slate, dark	30	"	295
Coal, "Coal"	2	"	297
SS., gray, "60′ Rock"	30	"	327
Slate, dark	36	"	363
SS., gray and brownish-gray	52	"	415
Slate, with gray shells	40	"	455
Slate, very dark	29	"	484
SS., soft bluish-gray . 70′; SS., hard, white 50′; SS., gritty olive-gray 30′; SS., shelly with dark slate 36′ ("**Big Injun**") "Mountain Sand"	186	"	670
Slate, dark	100	"	770
Slate, sandy and hard	37	"	807
SS., fine and hard, top gray, bottom very dark	28	"	835
Slate, bluish	100	"	935
Slate, shelly	90	"	1025
SS., dark gray	10	"	1035
Slate, sandy, dark	50	"	1085
Slate, dark	70	"	1155
Slate, purplish	52	"	1207
SS., olive-gray, "Second Sand" (**Gantz**)	6	"	1213
Red rock, sandy, chocolate color	4	"	1217
SS., olive-gray, flaky, "50′ and 30′ Rocks"	63	"	1280
Slate, sandy, dark	32	"	1312
SS., fine, dark gray, "Blue Monday"	6	"	1318
Red rock, soft "Big Red Rock"	18	"	1336

Slate, dark	20	"	1356
SS., gray, "Bowlder"	3	"	1359
Slate, bluish	23	"	1382
SS., with yellow pebbles "Stray Third"	29	"	1411
Slate, dark	1	"	1412
SS., coarse and gray, "Third Sand"	19	"	1431
Slate, dark	19	"	1450
Red rock	8	"	1458
Slate, purplish	24	"	1482
SS., yellowish-gray, very fine at bottom, "Fourth Sand"	27	"	1509
Slate, very dark	3	"	1512

Drilled dry. Cased at 486′. A little salt water in the "Mountain sand," below the casing, about half enough to drill with. Very little gas in the "Second sand." Oil in the "Third sand" at 1,415′, and no increase in the "Fourth." Torpedoed before being tubed with no apparent increase of oil. Average daily production, 15 barrels.

These records can be converted for ready comparison with the West Virginia series where the Pittsburg coal is used as the *Key rock,* by adding 875 feet to the interval from the top of the Ferriferous limestone, since the horizon of this latter stratum comes at approximately that distance below the Pittsburg coal. They were all taken with equal care by the same party, and exhibit in a striking way the rapid changes in the character of the strata within short distances. The "Second Sand" of these records is identical with the *Gantz sand* of Washington county, Pa., and it comes almost exactly 1,800 feet below the Pittsburg coal horizon, just as it does in Washington county, while the highest *red* or *purple* bed of the Catskill lies immediately on its top. The "*Third sand*" of these records appears to correspond with the *Gordon sand* of Washington county, but is only 2,050 feet below the Pittsburg coal, thus agreeing with the interval in the New Freeport field of Greene county, Pa., and the Marshall county field of West Virginia, rather than with the typical Gordon sand region at Washington, Pa., where the same interval measures 2,100 feet, as it does in many regions of Wetzel county, W. Va.

In this region of Butler county, Pa., the celebrated Speechley Gas sand, has recently been found petroliferous. The rela-

tions of this sand to the Venango Oil Sand Group is shown by the record of well No. 1 on the M. G. Black farm, Fairview township, Butler county, furnished me by Mr. John Worthington, of the South Penn Oil Company, which reads as follows:

M. G. Black Well No. 1.

	Feet.	Feet.
Interval	1050	to 1050
Second Sand, (Hundred-foot)	105	" 1155
Interval	265	" 1322
Third Sand	3	" 1325
Interval	40	" 1365
Fourth Sand	35	" 1400
Interval	840	" 2240
Speechley Sand	17	" 2257

Since the top of the "Second sand" or "Hundred-foot" of Butler county, lies about 935 feet below the *Ferriferous Limestone,* the Speechley sand would come 2,125 below that stratum or say, 3,000 feet below the horizon of the Pittsburg coal in the Pennsylvania region.

The top of the "Hundred-foot" sand (or Gantz and Fifty-foot combined) is found in northern West Virginia (Monongalia, Marion and Wetzel counties) at 1,850 to 1,900 feet below the Pittsburg coal, so that the horizon of the Speechley sand should be looked for at 3,050 to 3,100 feet under the Pittsburg coal in the northern West Virginia oil region. Only one well in the northern portion of the state, so far as the writer is aware, has been drilled deep enough to penetrate the Speechley sand horizon, and this is the Wheeling Deep well on Boggs Run, which passed through a gray sand with a showing of oil at 2,995′ or 1,095 feet below the top of the *Gantz sand* horizon. This might possibly represent the Speechley sand of Pennsylvania, since this interval below the top of the *Gantz horizon* is only a few feet less than in Butler county, and the westward thinning of the Devonian sediments would readily account for the discrepancy. Other wells in West Virginia should be drilled through this sand, since a new productive oil and gas horizon may result.

In the Thorn creek district of Butler county, Pa., the Gantz and "Fifty-foot" sands of the Petrolia region, coalesce into one solid mass, known as the "Hundred-foot," as shown in the following record from I-5, page 203.

Wallace Farm Well No. 16.

Thorn Creek district, Penn township, Butler county. Owners and authority: Fisher Oil Company.

	Feet.		Feet.
(?)	455	to	455
Limestone (Ferriferous)	20	"	475
(?) (680′ casing)	225	"	700
SS., Mountain sand	210	"	910
(?)	368	"	1278
SS., Gas sand (Berea)	40	"	1318
(?)	98	"	1416
SS., Hundred-foot	90	"	1506
(?)	74	"	1580
SS., Thirty-foot	28	"	1608
(?)	22	"	1630
SS., Blue Monday	20	"	1650
(?)	50	"	1700
SS., Boulder	5	"	1705
(?)	17	"	1722
SS., Third sand	30	"	1752
SS., Fourth sand	16	"	1768
(?) to bottom	4	"	1772

Another record from the southern portion of Donegal township, Butler county, drilled by the Fisher Oil Company on the Hickey farm, reads as follows:

Hickey Farm, Well No. 3.

November 29th, 1886. Contractors, Younkins & Co.

	Feet.		Feet.
(?)	330	"	330
Limestone, (Ferriferous)	22	"	352
(?) (560′ of casing)	218	"	570
SS., Mountain sand	200	"	770
(?)	130	"	900
SS., First sand	50	"	950
(?)	170	"	1120
SS., Gas sand (Berea)	50	"	1170
(?)	145	"	1315
SS., Hundred-foot	50	"	1365
(?)	15	"	1380
SS., Thirty-foot	20	"	1400
(?)	50	"	1450

SS., Blue Monday	15	"	1465
(?)	15	"	1480
SS., Boulder	15	"	1495
(?)	75	"	1570
SS., Third sand to bottom	39	"	1609

The "Gas" sand of these records is provisionally identified by the writer, with the "Berea Grit" of Ohio and West Virginia. The interval from the "Third," or Gordon sand up to the horizon of the Pittsburg coal, has here thickened up to a little over 2,100 feet, as we find by adding 875 feet for the thickness of the measures above the Ferriferous limestone.

Still farther to the southwest in West Deer township, Allegheny county, the measures continue to thicken as shown by the following record from page 241 I-5:

Armstrong Well.

Located on the Armstrong farm, north line West Deer township, Allegheny county. Owners, the Allegheny Syndicate. Authority, Wolf & Galey, contractors.

	Feet.		Feet.	
Conductor	12	to	12	
Slate and shells	358	"	370	
Slate	20	"	390	
Coal	5	"	395	
Limestone, (Ferriferous)	15	"	410	
Slate and shells	200	"	610	
SS., "Mountain Sands" (Big Injun)	225	"	835	
Slate and shells	50	"	885	
SS.	20	"	905	
Slate and shells	325	"	1230	
SS., "Gas Sand" (Berea)	97	"	1327	(Water at 1240′)
Slate	40	"	1367	
SS., "Hundred-foot"	113	"	1480	
Slate	5	"	1485	
SS.	20	"	1505	
Slate	25	"	1530	
Red rock	6	"	1536	
SS., "Thirty-foot"	30	"	1566	
Slate	25	"	1591	
SS., "Blue Monday"	20	"	1611	
Slate	2	"	1613	
SS.	15	"	1628	
Slate	20	"	1648	
SS., "Boulder or Third Sand"	25	"	1673	
Slate	30	"	1703	

SS., Oil sand unproductive	17	"	1720
Slate	40	"	1760
Red rock	20	"	1780
Slate	190	"	1970
SS., (Bayard)	30	"	2000
Slate and shells to bottom	243	"	2243
Unproductive		"	....

The names in parentheses are added by the writer (I. C. W.)

Here the interval to the "Third", or Gordon sand, from the Pittsburg coal, is 2,128 feet and to the "Hundred-foot" 1,847 feet, while to a sand which corresponds with the *Bayard* of Greene county, the interval is 2,450 feet.

Along the Ohio Valley, just below Pittsburg, some sand horizons beneath the "*Third,*" or *Gordon,* become oil and gas bearing as shown by the following record on the Smith farm, page 248-9 I-5:

Smith Well.

Located on the G. W. Smith farm, Ohio township, Allegheny county, Pa. Authority, Geo. H. Dimick.

Well mouth 100 feet below the "Crinoidal" limestone.

	Feet.		Feet.
Conductor	15	to	15
Slate	10	"	25
SS.	120	"	145
Coal blossom, slate, etc.	50	"	195
SS.	50	"	245
Slate	12	"	257
SS. and slate partings	78	"	335
Slate	15	"	350
SS., dark gray	50	"	400
Slate and shale (556′ of 5⅝″ casing	222	"	622
SS. in slate, irregular	68	"	690
SS. top white, coarse, bottom dark	300	"	990
Slate	35	"	1025
Shells	10	"	1035
SS.	95	"	1130
Slate	72	"	1202
SS.	28	"	1230
Slate	110	"	1340
SS., white, coarse (oil and gas in top, salt water 18′) (Berea horizon)	102	"	1442
Slate	15	"	1457
SS., bluish top, white bottom, fine (Hun-			

dred-foot)	133	"	1590
Slate (1630′ of 4¼″ casing)	75	"	1665
SS.	16	"	1681
Slate	17	"	1698
SS. "Clover seed" reddish at bottom	10	"	1708
Slate 3′, sand shells 9′, slate 8′	20	"	1728
SS., little oil (Third or Gordon)	18	"	1746
Slate and sand shells	46	"	1792
SS., white, fine (gas at top, oil at bottom) (Fourth)	28	"	1820
Slate	40	"	1860
SS.	3	"	1863
Slate, soft	4	"	1867
SS., "Simpson Gas Sand" (Fifth or McDonald)	17	"	1884
Slate, to bottom	56	"	1940

This record introduces a new sand, the (Fifth, or McDonald) at a lower horizon than the Fourth sand of the Butler county group, viz.: the one struck at 1,867 feet, or (by adding 400 feet), 2,267 feet below the horizon of the Pittsburg coal, while above it, in proper succession come the *Fourth, Third, Gordon, "Hundred-foot,"* and *Berea* sands, the latter being struck at 1,340 feet or 1,740 feet below the Pittsburg coal, since this coal belongs 400 feet above the derrick floor.

Another very interesting record is that of a well drilled by Jones & Laughlin on the South Side, Pittsburg, near the Monongahela river, given by Mr. Jno. F. Carll in the Annual Report of the Pennsylvania Geological Survey for 1886, page 730, as follows:

Jones & Laughlins' Well, No. 1.

Commenced July 10, 1884. Completed April 10, 1885. Located on the east side of Twenty-sixth street, near the river; Twenty-fifth ward, Pittsburg, South Side, at Messrs. Jones & Laughlin's American Iron and Steel works, Allegheny county, Pa. Well mouth above ocean 735 feet.

	Feet.		Feet.
Surface gravels, drive pipe	80	to	80
Sandy slate and sand shells	15	"	95
Slate, lead color	15	"	110
SS., white, medium grain, friable, mica	60	"	170
Shaly sandstone, fine, gray-black, mica	15	"	185
SS., gray, fine, a little slate near center	33	"	218

Slate	12	"	230
Sandy slate and shale, very fine, mica, some gray limestone and coal slate near top, trace of lime all through	58	"	288
Sandy slate and shells, dark	27	"	315
Slate, black, and trace of coal	20	"	335
Sandy slate and shells, faint trace of lime..	35	"	370
SS., white, fine, mica, grayish at top and bottom	70	"	440
Slate, black, coal (Drillers say 3′ of coal) ..	10	"	450
Sandy slate, dark, granulating like sand ..	55	"	505
Sandy slate and brown and white shells, trace of coal	15	"	520
Sandy slate, gray, fine, mica, large percentage of lime	20	"	540
Slate, black	45	"	585
Sandy slate and sandstone, fine, dark brownish-gray	10	"	595
SS., white, medium, compact, white specks..	50	"	645
Slate, black, trace of coal	10	"	655
SS., dark ash-gray, fine, friable	25	"	680
Sandy slate, chocolate-brown, fine, mica ..	30	"	710
Slate, dark, with gray shells	20	"	730
SS., white, medium, compact	40	"	770
Slate, black, with some coal	20	"	790
(?) specimens omitted	35	"	825
Siliceous limestone, (white sand and buff Limestone	20	"	845
Siliceous limestone, like bluish sandy shale.	8	"	853
Siliceous limestone, like gray light sand ...	27	"	880
Slate and gray sand shells	30	"	910
Sandy slate, dark, gray, fine, mica	35	"	945
SS., white, medium, compact, some dark slate at 1045′ and 1080′	160	"	1105
Slate, dark, pure	60	"	1165
White sand, and dark sandy slate, "salt and pepper rock"	35	"	1200
Sandy slate, and slate bluish	20	"	1220
SS., grayish, fine, flaky, mica, (white in center)	55	"	1275
SS., grayish, fine, flaky, mica, with layers of dark slate	20	"	1295
Slate, a little sandy, 20′ Slate, common, 45′ Slate, a little sandy, 65′	130	"	**1425**
SS., gray, fine, some lime, "Gas sand" (Berea)	25	"	1450
Slate, common, little sandy top and bottom.	75	"	1525

SS., white, top fine, center and bottom quite coarse (Hundred-foot)	93	"	1618
Slate, black, granulating like sand	7	"	1625
SS., white and brown mixed, fine	10	"	1635
Slate and shells, dark	8	"	1643
SS., white, top grayish and mixed with sandy slate, bottom white, little slate; pebble shell at 1650′	25	"	1668
Slate and sandy shells	7	"	1675
SS., white, medium, (Pebble shell at 1705′	45	"	1720
Sandy shale, red and green	20	"	1740
Slate and shells	15	"	1755
Slate, common	43	"	1798
SS., pebbly, (say 2′ pebbles and 5′ grayish sand, fine) good flow of gas (Gordon)	7	"	1805
Slate, black, iron pyrites (probably some shells at top)	15	"	1820
Slate, dark, with greenish-gray shells and streaks of red	13	"	1833
Slate, blue-black	27	"	1860
SS., yellowish-gray, fine, very hard	8	"	1868
Slate and shells	12	"	1880
Sandy slate, red and green, soft, with very red clay,	10	"	1890
SS., yellowish-gray, fine, hard	10	"	1900
Slate and shells, bluish-gray	3	"	1903
Slate and shells, greenish-gray and red,	12	"	1915
SS., yellowish-gray, medium	7	"	1922
Slate, common	24	"	1946
Slate and shells	8	"	1954
SS., yellowish-gray, medium, very hard	2	"	1956
Slate and sand, greenish-gray and red, lime	3	"	1959
SS., greenish-gray, with reddish slate (5th)	3	"	1962
Slate and shells	6	"	1968
Slate, sandy	11	"	1979
SS., white, fine, mica, flaky, hard	7	"	1986
Slate, common	22	"	2008
Slate with sand shells	17	"	2025
SS., white, very fine and hard	9	"	2034
Slate, common	132	"	2166
Slate, sandy, with some reddish layers	77	"	2243
Slate, a portion of it shelly	148	"	2391
Slate, sandy, much mica, bailings sometimes dark red	90	"	2481
Slate, common, fossils at 2485′	136	"	2617

SS. and slate, brownish-gray, micaceous	4	"	2621
Slate, with 2′ fossil band at 2660′	44	"	2665
Slate, with pyrites and some fossils	246	"	2911
Slate, some fossile bands	89	"	3000

"Some gas struck at 1798 feet; large flow at 1,804 feet." The sand at 1,954-1,986 feet is evidently the McDonald or Fifth oil sand, and it comes 429 feet below the top of the "Hundred-foot."

The Pittsburg coal crops in the hills here at 325 feet above the derrick floor, and hence that interval added to the depth at which any particular stratum was struck will give its horizon below this important geological level.

As a supplement to this record, and probably kept with a little more care, we give that of the Painter well about one mile distant, also starting on the bank of the Monongahela river, and at the same (325 feet) interval below the Pittsburg coal. It is given by Mr. Carll on page 739 of the Report for 1886, above referred to as follows:

Painter Well.

Located at the Iron works of J. Painter & Sons, on W. Carson street, Thirty-fourth Ward, Pittsburg; being under the cliffs on the south bank of the Ohio river, about midway between the Point bridge and Temperanceville. Compiled from a set of 94 sand pumpings, preserved by Mr. Harper, superintendent of Iron works. Well mouth above ocean in feet, 730.

(?) no specimen	40	to	40
Sandy shale and clay, light gray	30	"	70
Slate, gray	30	"	100
Shale, dark, fossils, (Upper Cambridge, L. S.)	5	"	105
Slaty sandstone, thin layers, micaceous	15	"	120
SS., ash-gray, friable, medium grain, mica	25	"	145
Slate, dark, gritty, micaceous	15	"	160
Shales, reddish and greenish	30	"	190
Shale, sandy, trace of red and limestone	23½	"	213½
Coal, slate with little coal (Lower Cambridge)	4½	"	218
SS., gray, with equal portion of dark slate	8	"	226

Slate, dark	34	"	260
Dark shales and gray sand shells	40	"	300
Slaty shale, dark, clayey	50	"	350
SS., gray and black sandy slate, fine, hard	20	"	370
Sandy slate and shale, gray, micaceous	15	"	385
Slate, common	38½	"	423½
Coal, bright and good, (Upper Kittanning)	4½	"	428
SS., friable, dark gray, fine (salt water)	52	"	480
Slate	95	"	575
SS., white friable, (salt water) (top of Pottsville)	57	"	632
Slate, common, (salt water)	23	"	655
SS., white, friable, little gas	25	"	680
Gray sand shells and slate	15	"	695
Slate, dark	50	"	745
Slaty shales, sandy, micaceous	15	"	760
Slate, common	25	"	785
SS., gray, with black sandy slate and lime (base of Pottsville)	10	"	795
Sand shells, gray, and limestone	10	"	805
SS., light gray limestone, (?)	55	"	860
Shaly slate, dark, gritty	15	"	875
SS., white, with black slaty shale	20	"	895
SS., white and grayish, friable massive (Big Injun)	175	"	1070
Slate, common	35	"	1105
SS., brownish-gray, very fine, tough	30	"	1135
Slate, common	30	"	1165
SS., greenish-gray, fine, flaky, mica	35	"	1200
Slate, common	60	"	1260
SS., greenish-gray, fine flaky, mica	10	"	1270
Slate, common	100	"	1370
Slate and shells, hard	10	"	1380
Slate, micaceous	45	"	1425
SS., gray, fine (much salt water) (Berea)	45	"	1470
Slate, dark, gritty, tough	70	"	1540
SS., gray top and bottom, white in center, (salt water) (Hundred-foot)	120	"	1660
Slate, common	5	"	1665
Slate, with red shales	5	"	1670
SS., white, fine, ("Thirty-foot")	25	"	1695
Slate, common	45	"	1740
Slate and shells	40	"	1780

Slate, common	35	" 1815
SS., dark gray, fine, tough (Gordon "Stray")	15	" 1830
Slaty shale, red, with greenish gray shells	8	" 1838
SS., grayish, fine, hard, (Gordon)	17	" 1855
Slate, common	45	" 1900
SS., white, flaky, (Fourth)	20	" 1920
SS. and shells, no specimen	52	" 1972
SS., gray, medium, some small pebbles, (gas) "Fifth or McDonald"	8	" 1980
Slate, common to bottom	34	" 2014

The sand struck at 1979 feet in the Jones & Laughlin well, evidently corresponds to the one struck at 1972 in the Painter well since both wells begin near the same geological horizon.

The deepest well ever drilled in the United States is the one put down by the Forest Oil Company during the active life of that organization under the presidency of Mr. W. J. Young of Pittsburg, now the chief executive officer of the South Penn Oil Company. This well is situated in Allegheny county, Pa., a few miles southwest from Pittsburg. Through the intelligent public spirit of Mr. Young the well was dedicated to science, and at my request, Prof. Wm. Hallock, the eminent physicist of Columbia University, was given every facility for testing the well for temperature, the results of which are published in connection with the record. The intention of Mr. Young was to drill the well into the *Corniferous Limestone,* but an accident left the tools and over 1,000 feet of cable in the well after it had been drilled to a depth of 5,575 feet, thus effectually plugging the hole, since all efforts to get hold of the broken cable were fruitless. An attempt to dissolve it with sulphuric acid was made, but after two years of unsuccessful efforts to clear the hole, it was finally abandoned much to the regret of Mr. Young, who had expended many thousands of dollars in the interest of pure science. This record as compiled by Mr. Young and Mr. Crocker, the superintendent of the Forest Oil Company, from the drilling samples, and kindly furnished the Survey for publication, reads as follows:

Deepest Well in the United States.

Drilled near West Elizabeth by the Forest Oil Company, 1898. Located on Wm. Bedell farm, 12 miles south southeast of Pittsburg, Allegheny county, Pa. Depth 5,575 feet.

Authority, Mr. W. J. Young; for temperature, Prof. Wm. Hallock, Columbia University, New York. Beginning 130 feet below the Pittsburg coal.

Slate	40	"	40	
Bottom of 10″ casing at	40	"	50	
Limestone	10	"	50	
Shales	80	"	130	
Slate	105	"	235	
Sand	30	"	265	
Slate	40	"	305	
Coal (Bakerstown)	3	"	308	
Slate	100	"	408	
Bottom of 8¼″ casing at	360	"	360	
Coal	2	"	410	
Slate	75	"	485	
Sand	40	"	525	(Temperature 57° Fahr.)
Shale	10	"	535	
Coal (L. Freeport)	2	"	537	
Slate	25	"	562	
Sand	65	"	627	
Shale	15	"	642	
Coal (M. Kittanning)	3	"	645	
Limestone	10	"	655	
Slate	30	"	685	
Limestone	15	"	700	
Slate	50	"	750	
Sand	35	"	785	
Slate	5	"	790	
Salt Sand	95	"	885	
Slate and shells	115	"	1000	
Slate	30	"	1030	
Red rock	20	"	1050	
Limestone (Big, M't., etc.)	50	"	1100	
Big Injun	310	"	1410	
Bottom of 6¼″ casing at 1320′	..	"	1320	
Slate and shells	60	"	1470	
Sand	15	"	1485	
Slate	7	"	1492	
Sand	5	"	1497	
Slate	18	"	1515	
Sand, (Berea?)	50	"	1565	

Slate and shells	60	"	1625	
Limestone	10	"	1635	
Slate and shells	100	"	1735	
Sand, (Gantz?)	25	"	1760	
Slate and shells	20	"	1780	
Limestone	10	"	1790	
Slate	20	"	1810	
Sand	15	"	1825	
Slate and shells	45	"	1870	
Sand	20	"	1890	
Slate	5	"	1895	
Sand ("Thirty-foot")	40	"	1935	
Slate	3	"	1938	
Sand } "Stray"	18	to	1956	
Slate } "Stray"	30	"	1986	
Sand } "Stray"	7	"	1993	
Red rock	3	"	1996	
Sand, (Gordon, Third, etc..	65	"	2061	
Red rock	5	"	2066	
Sand (Fourth)	30	"	2096	
Redrock and shells	15	"	2111	
Slate and shells	15	"	2126	
Sand	5	"	2131	
Slate	3	"	2134	
Sand	18	"	2152	
Redrock and shells	30	"	2182	
Sand (Fifth or McDonald)	25	"	2207	
Red rock and shells	35	"	2242	
Slate	10	"	2252	(Temperature 64° Fahr.)
Sand	5	"	2257	
Slate and shells	25	"	2282	
Sand (Bayard)	5	"	2287	(Gas, volume 25lb per min.)
Sand	10	"	2297	
Redrock	25	"	2322	
Slate and shells	75	"	2397	(Temperature, 78° Fahr.)
Sand (Elizabeth)	3	"	2400	
Shells	200	"	2600	
Slate	150	"	2750	
Slate and shells	200	"	2950	
Slate	100	"	3050	
Limestone and shells	100	"	3150	
Sand (Speechley?)	15	"	3165	
Slate	335	"	3500	
Sand (Bradford) trace of oil	20	"	3520	
Slate and shells	175	"	3695	
Slate and shells	195	"	3890	
Slate and shells	140	"	4030	

Slate and shells	180	"	4210	
Slate and shells	190	"	4400	
Slate and shells	75	"	4475	
Slate	23	"	4498	
Shells	2	"	4500	
Slate	32	"	4532	
Shells	13	"	4545	
Slate	25	"	4570	
Limestone	20	"	4590	
Slate	10	"	4600	
Sand	30	"	4630	
Slate	40	"	4670	
Limestone	20	"	4690	
Slate	20	"	4710	
Shells	15	"	4725	
Slate	15	"	4740	
Slate and shells	10	"	4750	
Sand	20	"	4770	
Slate	10	"	4780	
Limestone	10	"	4790	
Slate	20	"	4810	
Shells	10	"	4820	
Slate	20	"	4840	
Limestone	15	"	4855	
Slate	20	"	4875	
Shells	10	"	4885	
Slate	5	"	4890	
Slate and shells	10	"	4900	
Slate	15	"	4915	
Shells	5	"	4920	
Slate	30	"	4950	
Shells	5	"	4955	
Slate	45	"	5000	
Limestone	10	"	5010	(Temperature 120° Fahr.)
Slate	10	"	5020	
Slate and shells	10	"	5030	
Slate	20	"	5050	
Limestone	10	"	5060	
Slate	10	"	5070	
Slate and shells	10	"	5080	
Slate	10	"	5095	
Slate and shells	5	"	5100	
Limestone	5	"	5085	
Slate	30	"	5130	
Limestone	10	"	5140	
Slate	20	"	5160	
Limestone	10	"	5170	
Slate	10	"	5180	

Limestone	50	"	5230	
Slate	30	"	5260	
Limestone	10	"	5270	
Slate	20	"	5290	
Limestone	5	"	5295	
Slate	25	"	5320	
Limestone	10	"	5330	
Slate	30	"	5360	
Limestone	5	"	5365	
Slate	15	"	5380	(Temperature 127° Fahr.)
Limestone	10	"	5390	
Slate	20	"	5410	
Slate and shells	20	"	5430	
Slate	15	"	5445	
Limestone	5	"	5450	
Slate	20	"	5470	
Slate and shells	10	"	5480	
Slate	20	"	5500	
Slate	75	"	5575	(Bottom of 6¼″ hole.)

(The identifications in parentheses are added by I. C. W.)

The hole stopped in a dark shale supposed to be the *Marcellus,* and probably not more than 100 feet above the horizon of the Corniferous limestone, although of course, this is a mere inference based upon the fact that in the Conway deep well near Franklin, Pa., the top of the *Corniferous* was struck at 3,608 feet below the top of the Venango Oil Sand Group, while the drill in the Bedell well stopped at 3,840 feet below the same horizon, and hence the Devonian shales could not extend much deeper. The sand at 3,150 feet has been doubtfully identified with the *Speechley horizon,* since it underlies the Pittsburg coal by an interval (3,280 feet) 200 feet greater than in Butler county. This, however, would agree with the general southeastward thickening, and is what would be expected. Messrs. Young and Crocker are responsible for the identification with the *Bradford* horizon, of the sand struck at 3,500 feet.

The *Warren Sand* which, according to Oliphant, lies 350 feet above the Speechley sand, or 500 feet below the top of the *Fourth Sand* does not appear to have been represented by any distinct sand in this Bedell record. Its horizon belongs near the bottom of the 200 feet of "Shells" the top of which was struck at 2,400 feet.

A few records of wells drilled through the *Speechley Sand* in Armstrong county, Pa., one of them finding the *Bradford Sand,* have just been received through the kindness of Mr. Emmet Queen, of Pittsburg. They are published here, since they serve to illustrate the relation of the deep sands (Speechley, Bradford, etc.) of Pennsylvania to the higher *Venango Sands* (Gantz, Gordon, Fourth, etc.,) which with the *Big Injun* above, form the principal oil and gas producing horizons of West Virginia. The *Mountain Sand* of these records is the "*Big Injun Sand*" of West Virginia, the "*Hundred-foot*" represents the *Gantz and Fifty-foot,* while the *Third Sand* comes at the horizon of the *Gordon bed.*

Brady's Bend Well.

Armstrong county, Pa. Authority, Emmet Queen.

	Feet.		Feet.
Wood conductor	18	to	18
Unrecorded	17	"	35
Ferriferous limestone	20	"	55
Fireclay	15	"	70
Coal	4	"	74
Slate and shale	156	"	230
Mountain Sand, (Big Injun)	243	"	473
Slate and shale	162	"	635
First Sand	38	"	673
Slate and shale	185	"	858
Gas Sand, (Berea)	24	"	882
Slate and shale	102	"	984
Hundred-foot Sand	84	"	1068
Slate and shale	57	"	1125
Thirty-foot Sand	30	"	1155
Slate and shale	105	"	1260
Third Sand, (Gordon)	20	"	1280
Slate	10	"	1290
Fourth Sand "Boulder"	10	"	1300
Slate and shale	40	"	1340
Fourth Sand	17	"	1357
Slate and shale	503	"	1860
Beaty Sand, (Warren)	25	"	1885
Slate and shale	335	"	2220
Speechley Sand (fifteen feet of top of this sand was gray and full of pebbles) (Gas)	60	"	2280
Slate and shale, (in this was 300 feet red			

rock	1020	"	3300
Bradford Sand, (fifteen feet of top of this was full of pebbles, the balance was brownish color and honey combs and showed dark oil)	80	"	3380
Slate and red rock	137	"	3517
Total depth of well		"	3517

Joseph McElroy Well.

Armstrong county, Pa. Authority, Emmet Queen.

	Feet.		Feet.
Conductor, wood	18	to	18
Fireclay, slate and shales	172	"	190
Coal	4	"	194
Slate and shales	56	"	250
Coal	5	"	255
Slate and shale	30	"	285
Ferriferous limestone	16	"	301
Slate and shale	60	"	361
Sixty and Forty-foot Sand	80	"	441
Slate and shale	50	"	491
Mountain Sand (Big Injun)	250	"	741
Slate and shale	130	"	871
Sand	85	"	956
Slate and shale	175	"	1131
"Gas" Sand, (Berea)	20	"	1151
Slate and shale	189	"	1340
Hundred-foot Sand, (Gas)	75	"	1415
Slate and shale	131	"	1546
Third Sand, (Gordon)	11	"	1557
Slate and shale	58	"	1615
Fourth or Fifth Sand	25	"	1640
Slate and shale	480	"	2120
Beaty Sand, (Warren)	15	"	2135
Shales and slate	361	"	2496
Speechley Sand	81	"	2577
Slate, (Bottom of well)	15	"	2592

The Speechley Sand was hard on top for 15 feet, then a break of 20 feet of slate, then sand to bottom at 2,555, we got a little gas and show of oil. The well is shut in and is a good gas well from Hundred-foot Sand.

W. Stambaugh Well.

Armstrong county, Pa. Authority, Emmet Queen.

	Feet.		Feet.
Conductor, wood	15	"	15
Fireclay	80	"	95

Shales	40	"	135
Ferriferous limestone	15	"	150
Sand and shales	195	"	345
Seventy-foot Sand	70	"	415
Mountain Sand (Big Injun)	280	"	695
Shale and slate	205	"	900
First Sand	80	"	980
Shale and slate	30	"	1010
"Gas" Sand, (Berea)	20	"	1030
Slate and shale	70	"	1100
Hundred-foot Sand	90	"	1190
Slate and shale	30	"	1220
"Thirty-foot" Sand	25	"	1245
Slate and shale	65	"	1310
Boulder, Third Sand	10	"	1320
Slate and shale	40	"	1360
Third Sand	30	"	1390
Slate and shale	80	"	1470
Fourth Sand	16	"	1486
Slate and shale	60	"	1546
Fifth Sand	12	"	1558
Shales	566	"	2124
Beaty Sand, (Warren)	20	"	2144
Shale and slate	292	"	2436
Speechley Sand, top broken and shaly, (Gas)	45	"	2481
Slate and shale, to bottom	180	"	2661

Milt Claypool Well.

Armstrong county, Pa. Authority, Emmet Queen.

	Feet.		Feet.
Conductor, wood	8	to	8
Sand	200	"	208
Lower Kittanning Coal	4	"	212
Slate and shale	41	"	253
Ferriferous limestone	20	"	273
Sand, slate and shales	227	"	500
Seventy-foot Sand	80	"	580
Mountain Sand, (Big Injun)	400	"	980
Shales and slate	160	"	1140
Gas Sand, (Berea)	12	"	1152
Shales and slate	88	"	1240
Hundred-foot Sand	100	"	1340
Slate	10	"	1350
Thirty-foot Sand	40	"	1390
Sand, slate and shale	150	"	1540
Third Sand (Gordon)	10	"	1550
Slate and shale	80	"	1630

Fourth Sand	80	"	1710
Slate and shale	64	"	1774
Fifth Sand	6	"	1780
Slate and shale	442	"	2222
Beaty Sand, (Warren)	25	"	2247
Slate and shale	235	"	2482
Tiona Sand, (show of oil)	7	"	2489
Shale and slate	72	"	2561
Speechley Sand (this is bottom portion the top being broken with slate and shale)	20	"	2581

Charles Redd Farm Well.

Armstrong county, Pa. Authority, Emmet Queen.

	Feet.		Feet.
Conductor, wood	14	to	14
Fireclay, slate and shale	106	"	120
Ferriferous limestone	10	"	130
Slate and shale	92	"	212
Seventy-foot Sand	93	"	305
Slate and shale	50	"	355
Mountain Sand, (Big Injun)	245	"	600
Slate and shale	280	"	880
First Sand	80	"	960
Shales	130	"	1090
Hundred-foot Sand, (Gantz and Fifty-foot), (little gas)	90	"	1180
Slate and shale	170	"	1350
Third Sand, (Gordon)	30	"	1380
Slate and shale	70	"	1450
Fourth Sand	16	"	1466
Slate and shale	70	"	1536
Fifth Sand	8	"	1544
Slate and shale	566	"	2110
Beaty Sand, (Warren)	20	"	2130
Slate and shale	245	"	2375
Tiona Sand	10	"	2385
Slate and shale	46	"	2431
Speechley Sand	40	"	2471
Slate and shale	14	"	2485
Sand	8	"	2493
Slate and shale	132	"	2625
Sand	10	"	2635
Slate and shale, to bottom	140	"	2775

The *Ferriferous Limestone* comes near the base of the Allegheny Formation, at 825 to 875 feet below the horizon of the *Pittsburg coal.* This *Limestone* is a *Key* rock for the Venango Group of Sands, in Butler and Armstrong counties of Pennsyl-

vania, just as the *Pittsburg coal* is for the oil sands of West Virginia, and the horizon of the latter stratum with reference to any of the strata in these records can be found by adding 850 feet for the interval of the Ferriferous limestone below the Pittsburg coal.

These records show that several oil and gas sands belong in the interval between the Bayard Sand, and the Bradford Sand horizon, which have never yet been penetrated by any wells drilled in northern West Virginia except at the one deep well near Wheeling. Of course, none of these very deep sands may exist in West Virginia in good productive condition, but still the matter should be tested by the drill, since all the higher Pennsylvania horizons have proven richly oil and gas bearing in northern West Virginia.

The most carefully kept oil well record in Pennsylvania is that of the S. B. Phillips well, No. 1, of the Woodland Oil Company, in the McDonald field of Allegheny county. Through the intelligent co-operation of Mr. T. J. Vandergrift, the President of the Woodland Oil Company, a sample of the drillings was washed and preserved, every time the tools were removed from the hole, while steel line measurements were made at every important change in the character of the rock. From the driller's log, and the samples themselves a detailed record was made up by the writer and published in full in Vol. I, pages 214-226, West Virginia Geological Survey. The record of this well is of especial interest, occurring as it does in one of the most prolific oil pools ever discovered in the Appalachian field, and it will be given here in a summarized form as a standard for comparison since it occurs only 40 miles distant from the West Virginia State line:

S. B. Phillips Well, No. 1.

McDonald, Pa., oil field. Drilled by Wally and Seybert, contractors, for the Woodland Oil Company. T. J. Vandergrift, President.

	Feet.		Feet.
Unrecorded	86	to	86
Coal, Pittsburg	4	"	90

Fire clay	5	"	95
Gray sand	5	"	100
Limestone	19	"	119
Lime, shells and slate	11	"	130
Gray sand	24	"	154
Black slate	5	"	159
Gray sand and slate	41	"	200
White slate	19	"	219
Red rock	39	"	258
White slate	7	"	265
Coal, Elk Lick, and fire clay	5	"	270
White slate	35	"	305
Black slate	72	"	377
White slate	10	"	387
Gray sand, soft	72	"	459
Black, red and white slate	16	"	475
White slate	38	"	513
Gray sand and slate	16	"	529
Black slate	12	"	541
Dunkard or Cow Run Sand (Upper Mahoning)	50	"	591
Coal, Mahoning	7	"	598
White slate, red slate and shells and sand	105	"	703
Black and white slate	61	"	764
Coal, Lower Freeport	7	"	771
White slate, lime and shells	15	"	786
Black slate	53	"	839
Coal, Upper Kittanning, and slate	7	"	846
Fire clay; water	6	"	852
Black slate and fire clay	17	"	869
Coal, Middle Kittanning	3	"	872
Black slate and shells	12	"	884
Coal, Lower Kittanning and slate	5	"	889
Black slate and shells, and sand	34	"	923
Black sand, hard	14	"	937
Black sand, soft	15	"	952
Coal, Upper Clarion, and black slate	5	"	957 6″
Gray and black slate, and shells	10	"	967 6″
Coal, Lower Clarion, and black slate	3	"	970 6″
Black slate and shells	6	"	976
"Salt Sand", (Pottsville)	217	"	1193
Black slate and sand	39	"	1232
"**Big Injun**" **Sand,** hard	237	"	1469
Black and white slate, sand and shells	88	"	1557
"**Squaw Sand**" a hard gray sand with nine feet of black slate near the middle	42	"	1599
Black and gray shales, with some sandy			

beds	201	"	1800
Sand, white and blue, hard, (Berea?)	29	"	1829
Gray and black shales	77	"	1906
Red rock	14	"	1920
Black slate and shells	12	"	1932
"**Gantz**" **Sand**, top of "Hundred-foot" Sand, hard, grayish white	27	"	1959
Slate, "break"	11	"	1970
"**Fifty-foot**" **Sand**, hard, white and gray sand, gas and water at 13 feet below its top, no slaty layers	46	"	2016
Black slate and shells	79	"	2095
Cased 4⅞-inch at 2,023.			
'**Thirty-foot**" **Sand**, gray, hard	25	"	2120
Show of oil at 2,111	..	"	....
Black slate	27	"	2147
"**Stray**" and "**Gordon**" **Sands**, combined	63	"	2210
A little gas at 2,167, in upper gray portion ("Stray"); more gas at 2,188 and 2,193, in lower white portion ("Gordon")	..	"	....
Black slate, with a thin "stray" sand	43	"	2253
"**Fourth**" **Sand**, gray and white, hard	20	"	2273
Black slate and sand, hard	38	"	2311
"Fifth" or "McDonald" sand, "pay streak" or oil 19 feet below top, a gray sand	24	"	2335
Black slate to bottom of well at	7	"	2342

These Pennsylvania records, although many miles distant from the Mason and Dixon line, are yet very pertinent to the oil and gas interests of West Virginia since they reveal the fact that by deeper drilling it is posible to develop at least two more prolific horizons for either gas or oil in the West Virginia fields.

We shall now give a few records from the Pennsylvania counties (Fayette, Greene and Washington) which lie farther south and adjoin the West Virginia boundary.

A deep well was drilled by the Fayette County Gas Company on the Thompson farm, German township, Fayette county, Pa., which gave the following succession, according to Mr. Best, Superintendent of the Fayette Company:

Thompson Well, No. 1.

Thompson farm, German township, Fayette county, Pa. Authority, Fayette County Gas Company.

Limestone	8
Coal	290
Limestone, slate	295
Pittsburg coal	340
Ten-inch casing	352
Sand	624
Limestone, slate	654
Coal	861
Black sand	864
Limestone, slate	904
Coal	930
Sand, hard and little gas	1000
Lime slate	1005
White sand	1080
Eight and one-fourth-inch casing	1100
Coal	1150
Sand and little water	1240
Slate	1300
Sand, Salt with much water	1310
Bottom of Salt sand	1385
Six and one-fourth-inch casing	1410
Red rock and limestone	1412
Sand	1535
Red rock	1545
Top of Big Injun	1600
Top of pay streak by steel line	1736
By cable	1707
A little oil	1712
Little oil and water by steel line	1740
Bottom of Big Injun	1764
Four and seven-eighths-inch casing by steel line	1800
Squaw Sand	1774
Slate	1975
Shell and slate	2075
Gantz Sand (very hard and light in color) by steel line	2179
By cable	2140
Dark sand	2148
Fifty-foot Sand	2200
Dark sand	2213
Sand, a little gray	2244
Slate	2254
Sand, hard and blue	2259
Slate	2282
White sand	2288
Slate and shells	2317
Dark sand	2369

Slate	2375
Red rock	2392
Slate and shells	2398
Red rock	2403
Gordon Sand, light gray and hard	2412
Slate	2417
Sand	2422
Slate	2428
Fourth Sand, brown	2464
Red rock	2467
Fifth Sand	2493
Red rock and shells	2500
Dark sand	2592
Red rock	2632
Red sand	2662
Slate	2687
Sand	2700
Slate	2718
Bayard Sand	2748
Slate	2803
Elizabeth Sand by steel line	2850
By cable	2808
Slate	2819
Bottom of hole by steel line	2907

The identifications of the Gantz, Gordon, Fourth and Fifth Sands are as given by the driller's log, and may not be correct in all cases, but the Bayard sand struck at 2,408 feet below the Pittsburg coal would appear to be correctly placed, as also the Elizabeth Sand, 100 feet lower. This record is instructive as showing the difference between the usual cable measurements, and the more accurate steel line determinations, the latter being always 30 to 40 feet greater.

In Washington county, and one-half mile east from Beallsville, near the old National Pike, the record of a well drilled on the land of J. M. Miller by the Fayette County Gas Company was kept with much detail. It reads as follows, according to Mr. Jos. W. Craig, Vice President of the Company:

J. M. Miller Well, No. 1.

Beallsville, Washington county, Pa.

	Feet.		Feet.
Surface	10	to	10
Slate	7	"	17
Lime	12	"	29

Slate	15	"	44
Sand	10	"	54
Slate	26	"	80
Lime	15	"	95
Slate	10	"	105
Lime	55	"	160
Slate	5	"	165
Lime	68	"	233
Slate	15	"	248
Lime	24	"	272
Slate	18	"	290
Lime	10	"	300
Sand	55	"	355
Coal, Pittsburg	2	"	357
Slate	8	"	365
Lime	5	"	370
Black slate	6	"	376
Lime	44	"	420
Slate	20	"	440
Lime	10	"	450
Slate	10	"	460
Red rock	25	"	485
Lime	15	"	500
Red rock	34	"	534
Lime	28	"	562
Sand	38	"	600
Lime	12	"	612
Slate	15	"	627
Lime	21	"	648
Red rock	20	"	668
Lime	12	"	680
Lime	10	"	690
Red rock	10	"	700
Slate	15	"	715
Lime	10	"	725
Slate	13	"	738
Lime	17	"	755
Sand	30	"	785
Lime	10	"	795
Slate	10	"	805
Sand	25	"	830
Lime	28	"	858
Slate	27	"	885
Red rock	10	"	895
Slate	25	"	920
Sand	33	"	953
Slate	2	"	955
Lime	35	"	990

Slate	10	"	1000
Lime	15	"	1015
Slate	5	"	1020
Lime	10	"	1030
Sand	50	"	1080
Coal (U. Kittanning?)	5	"	1085
Slate	55	"	1140
Lime	20	"	1160
Sand	60	"	1220
Slate	5	"	1225
Sand	25	"	1250
Slate	70	"	1320
Lime	20	"	1340
Slate	5	"	1345
Lime	50	"	1395
Sand	15	"	1410
Slate	4	"	1414
White sand	26	"	1440
Black sand	20	"	1460
Slate	10	"	1470
Lime	10	"	1480
Red rock	10	"	1490
Lime, red	32	"	1522
Lime, white ("Big")	53	"	1575
Big Injun Sand	276	"	1851
Slate	44	"	1895
Sand	105	"	2000
Slate	90	"	2090
Lime	20	"	2110
Slate	19	"	2129
Lime	21	"	2150
Slate	10	"	2160
Shells and slate	30	"	2190
(Berea?) Sand	15	"	2205
Red rock	5	"	2210
Shells and slate	50	"	2260
Gantz Sand	19	"	2279
Slate	25	"	2304
Fifty-foot Sand	25	"	2329
Slate	16	"	2345
Sand	25	"	2370
Slate	35	"	2405
Sand ("Thirty-foot")	20	"	2425
Slate	25	"	2450
Red rock	10	"	2460
Shells and slate	22	"	2482
Sand (Gordon)	21	"	2503
Red rock	49	"	2552

Sand ("Fourth")	36	" 2588	Gas at 2564
Slate	18	" 2606	
Sand	14	" 2620	
Slate, sand and shells	70	" 2690	
Fifth Sand	15	" 2705	
Slate	25	" 2730	
Sand	25	" 2755	
Slate	10	" 2765	
Sand (Bayard)	15	" 2790	
Slate, sand and shells	410	" 3200	A little gas 3085
Conductor	15		
Ten-inch casing	414		
Eight-inch casing	858		
Six and one-half-inch casing	1470		

Well tubed with 4-inch tubing. Test first minute in 4-inch 281 pounds. Rock pressure after being shut in for 20 days 870 pounds.

The *Pittsburg coal* appears to have been quite thin in this well according to the driller's record, but this is probably only a local "roll." The sand at 2,190′ is doubtfully referred to the horizon of the Berea and it may possibly represent the Gantz. The record is interesting as showing the presence of the *Catskill red beds* above the horizon of the Gantz Sand, the uppermost member of the Venango Oil Sand Group. The principal flow of gas was found in the "Fourth" Sand.

About 10 miles west from Beallsville, and just west from Washington, a well has been drilled through the McDonald Sand on the land of Robert Wiley which gives the following results:

Robert Wiley, Well No. 1.

On the farm of Robert Wiley, one mile and a half west from Washington, Pa., Larkin and Townsell, authority.

	Feet.
Pittsburg Coal	519
Salt water at	1500
Fifty-foot Sand, top	2360
Gas, fair, flow at	2365
Bottom Fifty-foot Sand	2410
Top of Stray and Gordon Sand (gas at 2570′)	2560
Bottom of Stray and Gordon Sands	2640
Top Fourth Sand	2670
Bottom Fourth Sand	2688
Top Fifth Sand	2737
Bottom Fifth Sand	2753
Bottom of well	2774

This record exhibits the westward thinning of the intervals between important strata, a feature everywhere common in the Appalachian region.

Two important oil sands in the Venango Group received names from the region of Washington, Pa., viz.: the Gantz Sand, and the Gordon Sand. The former is found at a distance of 1,800 feet below the Pittsburg coal, and 700 feet under the top of the Big Injun Sand, while the Gordon Sand belongs about 2,100 feet below the Pittsburg coal on the Gordon farm, just west from Washington, Pa., where the succession was as follows in the first well on the Gordon farm, according to the late A. J. Montgomery, who sent me the following record:

Gordon Well, No. 1.

	Feet.	Feet.
Unrecorded		2113
Gantz Sand, brown	22	to 2135
Slate and sand	20	" 2155
"Fifty-foot" Sand, white	51	" 2206
Red, sandy shale	5	" 2211
Dark shales	107	" 2318
Sand, "Gordon Stray," gray	26	" 2344
Sand, Gordon, yellowish, white to bottom of hole	56	" 2400

As will be observed from this record the Gordon Sand (including its top or "Stray" member) is a thick stratum at its type locality, and this it maintains southward into West Virginia.

The red beds immediately under the "Fifty-foot" Sand mark a distinct stratigraphic horizon which can be followed as far southwest across West Virginia as the Little Kanawha river, beyond which they appear to fade away.

In Greene county, Pa., just west from Fayette and adjoining the line of Monongalia county, West Virginia, many wells have been drilled for both gas and oil, and a few of these records will prove instructive. One of these on the Mary A. Purman farm, about two miles northeast from Waynesburg, was drilled by the Chartiers Oil Company, Jos. W. Craig, President, and its record reads as follows:

Mary A. Purman Well, No. 1.

	Feet.	Feet.
Conductor		14
Pittsburg Coal		680
(Cased 10″ at 710 ft.) (Cased 8¼″ at 1560 ft.)		
Salt Sand, top (Water at 1772 ft.)		1590
Salt Sand, bottom (Cased 6⅝″ at 1830′)		1772
Big Lime	80	to 1900
Big Injun Sand	280	" 2180
Unrecorded	435	" 2615
Fifty-foot Sand	25	" 2640
Unrecorded	120	" 2760
Gordon Sand	20	" 2780
Unrecorded	6	" 2786
Fourth Sand		2786
Unrecorded	164	" 2950
Fifth Sand	20	" 2970
Unrecorded	150	" 3120
Bayard Sand (Gas at 3135′)	20	" 3140
Unrecorded	105	" 3245
Elizabeth Sand and gas at		3245
Total depth		3260

On Casteel Run, eight miles northeast from Waynesburg, several wells have been drilled to the Bayard, and lower sands. One of these on the Strickler farm gives the following succession according to the Carnegie Natural Gas Company:

Dempsey Strickler Well No. 1.

	Feet.	Feet.
Waynesburg Coal at		65
Pittsburg Coal at		413
Unrecorded	1287	to 1700
Big Injun Sand	240	" 1940
Unrecorded	460	" 2400
Fifty-foot Sand	60	" 2460
Unrecorded	300	" 2760
Fifth Sand	6	" 2766
Unrecorded	64	" 2830
Bayard Sand	10	" 2840
Unrecorded to bottom of well	164	" 3004

The *Bayard Sand* was named from the farm of Thomas Bayard, about four miles southeast from Waynesburg, Pa., where a very large gas well was obtained in it by the Carnegie Natural Gas Company. The record of this Bayard well, as furnished by Mr. N. Johnson, Superintendent of the Carnegie Natural Gas Company, reads as follows:

Thomas Bayard Well, No. 1.

	Feet.		Feet.
Unrecorded	555	to	555
Pittsburg Coal at			555
Unrecorded	1245	"	1800
Big Injun Sand	300	"	2100
Unrecorded	370	"	2470
Gantz Sand	40	"	2510
Unrecorded	5	"	2515
"Fifty-foot" Sand	65	"	2580
Unrecorded	135	"	2715
Gordon Sand	15	"	2730
Unrecorded	20	"	2750
"Fourth" Sand	20	"	2770
Unrecorded	65	"	2835
"Fifth" Sand	10	"	2845
Unrecorded	115	"	2960
Bayard Sand to bottom (gas)	5	"	2965

10″ Casing, 470′; 8″ Casing, 1160′. Packed well with 4″ tubing.

"Very large gas well at 2,960 feet, and could drill only five feet into the sand." "Rock pressure 1,100 pounds to the square inch."

As will be observed from the record, the top of the *Bayard Sand* comes 2,405 feet below the Pittsburg coal, 115 feet below the Fifth, or McDonald Sand, and 490 feet below the top of the Gantz Sand.

Several miles southwest from Waynesburg, on the land of Felix Bell, Wayne township, and only two miles from the West Virginia line, the Fort Pitt Gas Company found a large gas well in the McDonald or Fifth Sand. The record of this well was kept with much detail and is as follows, according to Mr. Jos. W. Craig, President of the Fort Pitt Gas Company:

Felix Bell Well, No. 1.

	Feet.		Feet.
Conductor	9	to	9
Unrecorded (13″ casing, 173½′)	266	"	275
"Bluff" Sand (Waynesburg) water	45	"	320
Mt. Morris Coal (Waynesburg)			320
Unrecorded	250	"	570
Coal, Mapletown (Sewickley)			570
Unrecorded	95	"	665
Coal, Pittsburg			665

Unrecorded (10″ Casing at 685′)	20	"	685
Lime and slate	90	"	775
Red cave	10	"	785
Slate and shells	90	"	875
Sand, dark	25	"	900
Slate	20	"	920
Red cave	40	"	960
Slate	30	"	990
Sand, dark gray	15	"	1005
Coal Blossom	..	"	....
Slate	35	"	1040
Red cave	20	"	1060
Slate and shell	95	"	1155
Red cave	10	"	1165
Sand, gray	55	"	1220
Coal blossom (Upper Freeport)	..	"	....
Slate	25	"	1245
Sand, light gray (water at 1370′)	130	"	1375
Slate and shell (8¼″ casing at 1382′)	25	"	1400
Sand, light gray (water 3 bailers an hour at 1430′	50	"	1450
Slate and lime	25	"	1475
Sand, white (hole full of water at 1525′)	70	"	1545
Slate	45	"	1590
Sand, white	25	"	1615
Slate	10	"	1625
Sand and lime, black	20	"	1645
Sand, white	30	"	1675
Slate	5	"	1680
Sand, dark gray (6⅝″ casing at 1706′)	70	"	1750
Red cave	70	"	1820
Slate and shell	40	"	1860
"Big" Lime	65	"	1925
"Keener" Sand, gas	20	"	1945
"Big Injun" Sand, white and gray	50	"	1995
Slate	20	"	2015
Sand, gray (bottom of "Big Injun")	70	"	2085
Five and three-sixteenth-inch casing at 2076′.			
Slate	5	"	2090
Sand gray	110	"	2200
Slate and shell	90	"	2290
Sand, black	5	"	2295
Slate and shell	145	"	2430
Sand, black	15	"	2445
Slate and shells	15	"	2460
Sand, dark gray ("Gantz")	35	"	2495
Slate and shell	130	"	2625
Sand, gray ("Fifty-foot)	25	"	2650

Slate		5	"	2655
Sand, brown		8	"	2663
Slate		4	"	2667
Sand, pink		18	"	2685
Shelly		45	"	2730
Sand, gray ("Stray")		30	"	2760
Slate and shell		10	"	2770
Sand, gray 10′				
Slate 3′	("Gordon")	35	"	2805
Sand, white 22′				
Slate and shell		20	"	2825
Sand, dark		5	"	2830
Slate and shell		20	"	2850
Sand, brown		5	"	2855
Slate and shell		10	"	2865
Sand, pink		5	"	2870
Slate		2	"	2872
Gas		..	"	...
Sand, dark gray ("Fourth")		13	"	2885
Slate and shell		29	"	2914
Shells		6	"	2920
Sand, dark		10	"	2930
Red slate and shells		17	"	2947
Sand, gray 16				
Slate 2	McDonald or			
Sand, dark 12	Fifth Sand			
Slate 10	(Gas at 3001′)	61	"	3008
Sand, dark 3				
Slate 3				
Sand (small pebbles) 15				
Total depth				3008

The thickness of the Venango Oil Sand Group in this well from the top of the "Gantz" to the bottom of the "Fourth" is 425 feet, and to the bottom of the "Fifth" Sand is 548 feet, the McDonald Sand being unusually thick (61 feet) A heavy flow of gas was struck at 3,001 feet, or 2,336 feet below the Pittsburg coal, with "rock pressure" of more than 900 pounds to the square inch.

About two miles north from the Felix Bell well, two others were drilled for gas by the same company (Fort Pitt) on the land of the Kuhn heirs. No. 1 is a very deep well, and its record is as follows, according to Mr. Jos. W. Craig:

Lewis Kuhn Heirs' Well, No. 1.

	Feet.		Feet.
Unrecorded	750	to	750
Coal, Pittsburg			750
Unrecorded	370	"	1120
Dunkard Sand	30	"	1150
Unrecorded	470	"	1620
Salt Sand	147	"	1767
Unrecorded	239	"	2026
Big Injun Sand	174	"	2200
Unrecorded	516	"	2716
"Fifty-foot" Sand	..	"	....
Unrecorded	215	"	2931
"Gordon (more probably "Fourth" Sand)	..		....
Unrecorded	117	"	3048
Fifth Sand (Gas 3052 and 3092)	52	"	3100
Unrecorded	150	"	3250
Hard, limy sand	300	"	3550
Soft and red shale	5	"	3555
Sandy lime	20	"	3575
Soft slate	15	"	3590
Sandy lime	60	"	3650
Sand, white (Speechley?)	15	"	3665
Soft slate	10	"	3675
Sandy lime to bottom	105	"	3780

The sand struck in this well at 3,650 feet, or 2,900 feet below the Pittsburg coal is near the horizon of the Speechley sand of Butler, Armstrong, and other Pennsylvania counties farther north, and its presence here in the only well that has been drilled through this horizon in Greene county, would lead to the conclusion that with more tests, it might prove oil and gas bearing in many portions of West Virginia.

The Lewis Kuhn Heirs' well, No. 2, lies west from No. 1, and shows the following succession, according to Mr. Jos. W. Craig, of the Fort Pitt Gas Company:

Lewis Kuhn Heirs' Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	955		
Dunkard Sand	1358	to	1400
Gas Sand	1754	"	1790
Salt Sand	1815	"	1965
Red rock	1980	"	2030
Lime and slate	2030	"	2170
"Big" Lime	2170	"	2235

Big Injun	2235	"	2495
"Fifty-foot" Sand	2910	"	2965
Fifth Sand (gas 3273′)	3225	"	3290
Total depth			3298

Minute pressure, 200 pounds in 3-inch tubing.
Rock pressure, 920 pounds.

About three miles southwest from the Kuhn Heirs' land, some good gas wells have been found in the Big Injun Sand near the West Virginia-Pennsylvania line in Greene county, and the record of one of these on the farm of Jacob Simpson, two miles east of Jollytown, reads as follows, according to the Hope Natural Gas Company:

Jacob Simpson Well, No. 1.

	Feet.		Feet.
"Bluff" (Waynesburg) Sand	300	"	355
Mapletown (Sewickley) Coal	620		
Pittsburg Coal	703	"	710
Little Dunkard Sand	1130	"	1170
Big Dunkard Sand	1210	"	1270
Gas Sand	1420	"	1500
Salt Sand	1560	"	1733
Red rock	1803		
Big Lime	1929	"	1965
Big Injun Sand	1965		
Gas at	2062		
Gas, second pay	2067		
Total depth	2073		

"Seven hundred pounds rock pressure."

The rock pressure of the "Big Injun" Sand gas in the vicinity of Blacksville, five miles east from the Simpson well where the top of this sand lies approximately 200 feet higher, was 600 pounds when the pool was first opened, or 100 pounds less than in the Simpson well.

Some large gas wells have been drilled around Jollytown, Greene county, near the West Virginia line. These wells get their gas mostly in the Fifth, or McDonald Sand. One of these wells on the L. B. & S. S. Clovis farm, two miles northeast from Jollytown, had the following record, according to the Fort Pitt Gas Company:

L. B. & S. S. Clovis Well No. 1.

Gilmore township, Greene county, Pa.

	Feet.		Feet.
Bluff (Waynesburg) Sand	375	"	440
Pittsburg Coal			785
Salt water at			1680
Big Injun Sand	2060	"	2325
Gantz Sand	2640		
Fifty-foot Sand	2764	"	2820
Red beds	2850	"	2870
Fifth Sand, gas	3068	"	3100
Bayard Sand	3130	"	3160
Elizabeth Sand	3278		

"No definite formation of Elizabeth Sand."

About three miles west from Jollytown, a well was bored by the Philadelphia Company on the land of Salathiel Lemmon, the record of which reads as follows:

Salathiel Lemmon Well, No. 1.

	Feet.		Feet.
Waynesburg Coal	450	to	455
Mapletown (Sewickley) Coal	704	"	710
Pittsburg Coal	817	"	826
"Murphy" Sand (Morgantown)	950	"	980
Little Dunkard Sand	1330	"	1390
Gas Sand	1485	"	1585
Salt Sand	1635	"	1740
"Big" Lime	2035	"	2100
Big Injun Sand	2100	"	2340
Fifty-foot Sand	2850	"	2875
Gordon (Stray)	2900	"	2920
Gordon Sand	2930	"	2938
Fourth Sand (Show oil 3031)	3005	"	3047
Slate	3047	"	3477

These were all cable measurements, and are, therefore, not strictly accurate. The Fifth and Bayard Sands both appear to have been absent in this boring.

In this record the driller has given the name "Murphy" Sand to the stratum which comes at the horizon of the Morgantown sandstone.

About five miles west from the Lemmon well, and near Deep Valley, Greene county, the Silas Barnhart well, No. 1, drilled by Mr. Charles Tague, gives the following succession:

Silas Barnhart Well, No. 1.

	Feet.		Feet.
Wood conductor	16		
Mapletown (Sewickley) Coal	1284	to	1288
Pittsburg Coal	1338	"	1344
"Murphy" Sand	1568	"	1590
Dunkard Sand	1740	"	1800
Gas Sand	2090	"	2195
Salt Sand	2255	"	2375
Maxton Sand	2435	"	2500
Pencil Cave	2500	"	2506
Big Lime	2506	"	2585
Big Injun Sand	2585	"	2880
Fifty-foot Sand	3318	"	3358
Gordon Sand	3380	"	3398
First Oil	3393		
Total depth	3398		

This well starts on top of the Gilmore Sandstone of the Dunkard Formation, and it, therefore, gives a vertical measurement from that stratum down to the Pittsburg Coal, as well as the base of the Dunkard beds, about 300 feet higher.

The sand called the "Gordon" throughout this district, occurs at only about 2050 feet below the Pittsburg coal, and hence may be the upper or "Stray" member of that sand horizon.

About one-half mile northwest from the Barnhart well, the South Penn Oil Company has drilled a well on the Rossell-Sammons farm through the Fifth, or McDonald Sand, which gives the following succession:

Rossell-Sammons Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	1233		
"Murphy" (Morgantown) Sand	1444	to	1464
Dunkard Sand	1753	"	1783
"Gas" Sand	1953	"	1983
Maxton Sand	2351	"	2381
Pencil Cave	2381	"	2386
Big Lime	2386	"	2448
Big Injun Sand	2448	"	2738
Gantz Sand	3047	"	3055
"Thirty-foot" Sand	3204	"	3249
Gordon Sand	3289½	"	3330
Dry in Gordon.			
Fourth Sand (show oil at 3389)	3384	"	3416
Fifth Sand	3454	"	3455

Total 3478
(Five-barrel well in Fourth Sand.)

As may be seen from this record, the interval between the Pittsburg coal and the Fifth, or McDonald, Oil Sand has decreased about 100 feet in passing northwestward 15 miles from the Felix Bell well on Hoover's run, as given on a previous page.

About two miles northwest from the Sammons well and one and a half southwest from Aleppo Postoffice the No. 2 well on J. J. S. Moore gave the following succession, according to the South Penn Oil Company:

J. J. S. Moore Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	1030		
"Murphy" (Morgantown) Sand	1215		
Dunkard Sand	1575	to	1600
"Gas" Sand	1720		
Salt Sand	1943	"	2073
"Little" Lime	2140	"	2190
"Big" Lime	2198	"	2254
Big Injun Sand	2254	"	2478
Gantz Sand	2821	"	2867
"Fifty-foot" Sand	2960	"	3087
Fourth Sand	3138	"	3154
Fifth Sand	3253	"	3263
Sand (Bayard?)	3300	"	3303
Total depth	3343		
(Dry)			

Here the Gordon Sand appears to be wanting unless the upper portion of the *Fourth Sand* should be regarded as a lower *Gordon* horizon.

On the F. A. Gover farm, three and one-half miles southwest from New Freeport, and near the West Virginia-Pennsylvania line, the South Penn Oil Company reports the following succession in Well No. 3:

F. A. Gover Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	1070		
Dunkard Sand	1535	to	1555
Salt Sand (gas at 2035')	2004	"	2095
"Big" Lime	2240	"	2288
Big Injun Sand	2288	"	2560
Gantz Sand	2891		
"Fifty-foot" Sand	3048	"	3103

Gordon Sand	3127½	"	3150
Fifth Sand (gas at 3303′)	3297	"	3309
Sand (Bayard?)	3343	"	3360
Sand and shells to	3466		

The sand reported at 3343′ to 3360′ may possibly represent the Bayard horizon. It is the same one as that struck in the J. J. S. Moore No. 2 at 3300 feet.

To show the persistence of the Venango Oil Sand Group, we give here the records of two wells in northern Greene county, near Nineveh, 25 miles distant from the Gover farm. These records are as given to the late Mr. John F. Carll, by Mr. John Worthington, and published in Report I-5, Second Geological Survey of Pennsylvania, pages 308-311:

Smith Well, No. 3.

Located on the John H. Smith farm, Morris township, Greene county, Pa., about one mile north 54° west of Nineveh. Owners, The Nineveh Petroleum Company. Authority: John Worthington, Manager.

	Feet.		Feet.
Conductor	18	to	18
SS., shelly	25	"	43
Limestone	22	"	65
SS.	25	"	90
Coal, "Nineveh"	2	"	92
Slate and limestone	63	"	155
Coal	1	"	156
Shale and limestone	40	"	196
Slate	25	"	221
Sand shells, slate and limestone	79	"	300
Slate, sand, shells and limestone	240	"	540
SS.	40	"	580
Coal, "Waynesburg"	4	"	584
Fire clay and slate	15	"	599
Slate, sand, shells and limestone	240	"	839
Slate	20	"	859
SS.	21	"	880
Coal, "Pittsburg"	6	"	886
Shale	15	"	901
Limestone and shale	88	"	989
SS.	25	"	1014
Red rock	15	"	1029
Limestone and shale	25	"	1054
SS.	65	"	1119
Slate	5	"	1124

Red rock	10	"	1134
Limestone and sand shells	20	"	1154
Slate	5	"	1159
Limestone	10	"	1169
SS.	20	"	1189
Red rock	20	"	1209
Limestone	10	"	1219
SS.	18	"	1237
Slate	20	"	1257
SS.	20	"	1277
Slate	60	"	1337
Sand shells and slate	30	"	1367
SS., "Mahoning"	30	"	1397
Slate	10	"	1407
SS.	70	"	1477
Slate and sand shells	100	"	1577
SS.	15	"	1592
Slate	35	"	1627
SS.	50	"	1677
Slate	25	"	1702
Limestone, fire clay and shale	83	"	1785
Slate	5	"	1790
SS., bluish-gray	85	"	1875
SS., white	80	"	1955
SS., bluish-gray	15	"	1970
Slate	40	"	2010
Limestone and sand shells	55	"	2065
SS., "Big Injun"	280	"	2345
Slate	310	"	2655
SS., fine, bluish-gray. "Gantz"	40	"	2695
Sand shells	50	"	2745
Slate	60	"	2805
SS.	8	"	2813
Slate	27	"	2840
SS.	30	"	2870
Slate	65	"	2935
SS., "Gordon"	35	"	2970

"Three hundred and ten barrel well at 20 feet in the Gordon Sand."

Auld Well.

Located on the Hugh Auld farm, about two miles north 15° west of Nineveh, Morris township, Greene county, Pa. Owners, the Nineveh Petroleum Company. Authority: John Worthington, Manager.

	Feet.		Feet.
?	560	to	560
Coal, "Waynesburg"	4	"	564

?	302	"	866
Coal, "Pittsburg"	6	"	872
?	1128	"	2000
Limestone	60	"	2060
SS., Big Injun, "Upper" (gas at 2080′)	80	"	2140
Slate	80	"	2220
SS.	8	"	2228
Slate	4	"	2232
Shells and slate	178	"	2410
Slate	170	"	2580
SS.	10	"	2590
Slate	35	"	2625
SS., "Gantz and Fifty-foot"	80	"	2705
Slate	45	"	2750
Red rock	10	"	2760
Slate	70	"	2830
SS., white ("Thirty-foot")	10	"	2840
SS., red	30	"	2870
Slate	40	"	2910
SS., "Gordon"	29	"	2939
Slate	11	"	2950
Red rock	20	"	2970
Shale	20	"	2990
Slate	10	"	3000
SS., "Fourth Sand" (large quantity salt water)	11	"	3011

Unproductive.

The Oil Sand struck at 2935 feet in the Smith well, 2049 feet below the Pittsburg coal, by Mr. Worthington, in July 1888, was identified by him as the Gordon Sand of Washington county to the north, and has ever since been so designated by the oil fraternity, having proved productive of oil and gas in a nearly continuous belt from Nineveh southwestward into Wetzel and other counties of West Virginia for a distance of 50 to 60 miles or more.

Mr. Worthington and others (the writer included) have some times thought it possible that this very productive oil horizon of the New Freeport district in Greene county might not represent the *Gordon Sand* of Washington, but possibly the "Thirty-foot" Sand between it and the "Fifty-foot" horizon. But this inference is formed only upon the lessened interval (2050′ instead of 2100′) between the sand in question and the Pittsburg coal, but as this interval is but 50 feet less than that at Washington, and is the same as it is in Butler county, between the Pittsburg coal and

the great Third Oil Sand of the Butler, Armstrong, Clarion and other producing fields of the Venango Sand region to the northeast, it appears quite probable that the original identification as given in I-5 is correct. At any rate, it is the nomenclature universally used by the oil producing interests in Greene, Wetzel, Marshall, Tyler and Doddridge counties.

Having now reviewed the underground structure of the strata in the counties of Pennsylvania, immediately north from the West Virginia border we shall first give a series of records from wells drilled in the northern counties of West Virginia beginning with Monongalia, and proceeding westward.

MONONGALIA COUNTY WELL RECORDS.

In 1900 a party from Cleveland, Ohio, drilled a test well near Uffington, three and one-half miles south from Morgantown, on the F. M. Johnson farm. The derrick floor is about ten feet above the *Upper Freeport coal.* The record as given me by one of the persons interested, is as follows:

F. M. Johnson Well, No. 1.

	Feet.		Feet.
Conductor	20	to	20
Limestone (Freeport)	16	"	36
Sand	20	"	56
Slate	24	"	80
Coal (Lower Freeport)	1	"	81
Slate and shell	65	"	146
Limestone	12	"	158
Slate	48	"	206
Sand, bottom, hard	5	"	211
Slate and shells	30	"	241
Limestone	20	"	261
Slate	40	"	301
Sand (top Pottsville)	70	"	371
Slate	30	"	401
Sand	65	"	466
Slate	54	"	520
Red rock	10	"	530
Slate and shells	70	"	600
Maxton Sand	75	"	675
Red rock	50	"	725
Limestone	10	"	735
Black slate	40	"	775
Slate and shells	25	"	800

Lime to top of Big Injun Sand	50	"	850
Sand, black	10	"	860
Cased on Sand at 860′		"	...
Sand, (Big Injun)	130	"	990
Slate and shells	70	"	1060
Sand	130	"	1190
Slate	65	"	1255
Limestone	25	"	1280
Slate and shells	40	"	1320
Sand (Gantz)	16	"	1336
Slate and shells	100	"	1436
Sand, hard	55	"	1491
Slate	5	"	1496
Sand, hard (Gordon)	44	"	1540
Slate and shells	40	"	1580
Red rock and black slate	255	"	1835
Red rock and slate, caving		"	....
Dark Sand (Bayard)	85	"	1920
Slate	10	"	1930
Dark sand with hard streaks, screw of slate every 15 or 20 feet	100	"	2030
White slate to bottom	250	"	2280

The Pittsburg coal belongs about 575 feet above the mouth of the well, and hence the bottom stopped about 200 feet above the horizon of the Speechley Sand. Only slight shows of oil and gas were found in any of the sands.

About two and one-half miles west from Morgantown, a well was drilled by Messrs. Courtney & McDermott on the land of J. W. Holland, beginning only ten feet under the Pittsburg coal, an opening in which is near the derrick. The contractor, Richard Myers, is authority for the following record of this well:

J. W. Holland Well, No. 1.

	Feet.		Feet.
Conductor	0	to	15
Slate and lime	15	"	147
Lime	147	"	187
Red rock	187	"	197
Slate and lime	197	"	375
Little Dunkard Sand	375	"	420
Slate and lime	420	"	515
Slate and lime shells	515	"	715
"Gas" Sand	800	"	825
Slate	825	"	835
Salt Sand (water 850′)	835	"	915
Slate	915	"	970

Slate	970	"	1015
Red rock	1015	"	1025
Lime	1025	"	1125
Red rock	1125	"	1175
Pencil cave	1175	"	1180
"Big" Lime	1180	"	1310
Red rock	1310	"	1315
Big Injun Sand	1315	"	1413
Slate	...	"	....
Sand to	1488		
Slate	1488	"	1492
Gas in Sand ("Squaw") at	1555		
Slate at	1600		
Lime at	1660		
Sand (Gantz and "Fifty-foot")	1835	"	1930
Red rock	...	"	....
Fifth Sand	2307	"	2342
Slate and shell	...	"	....
Sixth Sand (Bayard)	2405	"	2440
Slate and lime to bottom	2440	"	2615

The Marion Tennant Well, No. 1 was drilled by the Chartiers Oil Company near Daybrook, Monongalia county, about 15 miles west from Morgantown. Its record is as follows, according to Jos. W. Craig, President Chartiers Oil Company:

Marion Tennant Well, No. 1.

	Feet.		Feet.
Pittsburg Coal			795
Big Injun Sand	2100	to	2250
Squaw Sand (oil 2195′)	2265	"	2300
Gantz Sand			2630
Fifty-foot Sand			2690
Sand			2710
Fifteen feet slate			2725
Thirty-foot Sand			2770
Pink rock			2800
Red rock			2915
Stray Sand and Gordon			2930
Fourth Sand	3012	"	3032
Slate and shells			3060
Black Sand			3060
Red sand			3080
Slate			3100
Shell			3055
Fifth Sand, shell, one bit			3090
Gas in shell (Bayard Sand)			3220

"Oil and water 2195 to 2210; filled up about 1200 feet.

Fourth Sand about 20 feet, poor, dark sand. Fifth Sand only one bit. Got gas at 3220 (very little). Got oil at 3224, filled up over tools, probably good for one barrel oil per day. Did not exhaust by drilling. Oil in Black Sand, 3224′. Only one bit From 3224′ to bottom, black slate. Bottom of hole 3276 feet.''

The oil obtained near the bottom of this well is from the horizon of the Bayard Sand, the same as that found a few miles northeast on the Blair and Shriver farms, close to the West Virginia-Pennsylvania line.

The Flat Run Oil Pool of Marion county extends into Monongalia, west from Daybrook, and many productive wells have been drilled therein. The oil occurs in what the drillers term the ''Gordon'' Sand, but as the oil is found at about 2220 feet below the Pittsburg coal, it is evidently below the ''Gordon'' Sand horizon of Greene, Wetzel, etc., or even below the Campbells run ''Gordon'' horizon of the next western oil belt in Monongalia, and hence the writer has identified this *Flat Run ''Gordon'' Sand* with the *Fourth Sand* of the Pennsylvania or Venango Group.

The following records from the Flat Run pool in Monongalia county will show the succession of strata in the region between the north end of that pool, two to three miles west from Daybrook, and the Marion county line:

Hamilton Gump Well, No. 1.

Authority, South Penn Oil Company.

	Feet.	Feet.
Pittsburg Coal	1175	
Big Injun Sand	2483	to 2690
Sand, slate and shells	2975	
Slate and shells	3020	
Sand	3025	
Slate, sand and shells	3045	
''Fifty-foot'' Sand	3100	
Soft slate	3120	
Sand, slate and shells	3150	
Sand and shells	3210	
Red rock	3215	
Sand	3230	
Red rock	3270	
Sand	3280	
Slate and shells	3290	
Sand	3295	

Slate and shells	3310
Red rock	3345
Sand	3355
Slate	3360
Sand	3375
Slate and shells	3390
First Pay (Fourth Sand)	3391
Second Pay	3396
Depth	3408

Anna Harvey Well, No. 1

Authority, South Penn Oil Company, Flat Run Pool, Monongalia county.

	Feet.		Feet.
Pittsburg Coal	780		
Big Injun Sand	2080	to	2260
Slate and shells	2285		
Squaw Sand	2315		
Slate and shells	2500		
Shelly Sand	2520		
Slate	2530		
Sand (Gantz)	2555		
Slate, sand and shells	2625		
"Fifty-foot" Sand	2660		
Slate	2675		
Sand	2725		
Red sand	2730		
Slate, sand and shells	2770		
Red sand	2785		
Slate	2790		
Sand	2820		
Red rock	2835		
Sand	2885		
Shells and slate	2905		
Red rock	2925		
"Stray" Sand (Campbells Run)	2945		
Slate and shells	2995		
Fourth Sand	2995		
First Pay	3005		
Second Pay	3010		
Bottom	3012		

Anna Harvey Well, No. 3. Authority, South Penn Oil Company. Flat Run Pool, Monongalia county.

	Feet.		Feet.
Pittsburg Coal			920
Big Injun Sand	2225	"	2370
"Fifty-foot" Sand	2785	"	2830

"Stray" Sand (Campbells Run)	3085	"	3125
Fourth Sand	3130		
First Pay	3133		
Total depth	3152		

"Show oil and light gas in Injun."
"Light gas in Fifty-foot Sand."

Haught & Walker Well, No. 2. Authority South Penn Oil Company. Flat Run Pool, Monongalia county, West Virginia.

	Feet.		Feet.
Pittsburg Coal	1060		
Big Injun Sand (Show of oil 2400′)	2360	to	2525
"Fifty-foot" Sand (light gas, 2980′)	2965	"	3010
Stray Sand	3260	"	3270
Fourth Sand	3281		
First Pay	3285		
Total depth	3288		

Haught & Walker Well, No. 18. Authority, South Penn Oil Company. Flat Run Oil Pool, Monongalia county.

	Feet.		Feet.
Pittsburg Coal	1077		
Big Injun Sand	2367	to	2517
"Fifty-foot" Sand	2977	"	3027
Stray Sand	3250	"	3280
Fourth Sand (oil)			3295
Second Pay			3301
Total depth			3316

B. F. Haught Well, No. 1. Authority, South Penn Oil Company. Flat Run Oil Pool, Monongalia county.

	Feet.		Feet.
Pittsburg Coal	1052		
Big Injun Sand	2400	to	2525
"Fifty-foot" Sand	2957		
Stray (Campbells Run Sand)	3215		
Gordon	3265		
First Pay	3275		
Second Pay	3283		
Total depth	3293		

B. F. Haught Well, No. 2. Authority, South Penn Oil Company. Flat Run Oil Pool, Monongalia county, West Virginia.

	Feet.		Feet.
Pittsburg Coal			1255
Big Injun Sand (gas at 2635′)	2550	to	2695
Fifty-foot" (gas at 3160′)	3150	"	3220
Stray Sand	3450	"	3460
Fourth Sand	3474		

First Pay	3483
Total depth	3495

J. N. Wilson Well, No. 1. Authority, South Penn Oil Company. One and one-half miles southeast of Miracle Run Postoffice, Clay district, Monongalia county.

	Feet.		Feet.
Bluff (Waynesburg) Sand	450		
Mapletown Coal	815		
Pittsburg Coal	915		
Little Dunkard Sand	1170	to	1200
Big Dunkard Sand	1450	"	1500
"Gas" Sand	1600	"	1660
Salt Sand	1730	"	1880
Little Lime	2110	"	2130
Pencil cave	2130	"	2135
Big Lime	2140	"	2188
Big Injun Sand	2188	"	2410
Gas (small) at	2770		
"Fifty-foot" Sand	2882		
Fourth Sand	3152		
Oil at	3156		
Total depth	3170		

Isaac Lemley Well, No. 2. Authority, South Penn Oil Company. One and one-half miles southeast of Miracle Run Postoffice, Clay district, Monongalia county, West Virginia.

(Steel line.)	Feet.		Feet.
Bluff Sand (Waynesburg)	580	to	640
Pittsburg Coal	1020		
Dunkard Sand	1780	"	1835
Salt Sand	1870	"	2031
Pencil cave	2190	"	2197
Big Lime	2197		
Big Injun Sand	2295		
First gas	2305		
Second gas	2386		
Oil	2390		
Total depth	2414		

Along the Mt. Morris-Mannington Big Injun Sand oil belt, the Bayard Sand, at approximately 2400 feet below the Pittsburg coal, has recently been found very productive of oil in the vicinity of Amos, or Fairview, Marion county, and northeastward into the southern edge of Monongalia. Small oil wells had previously been found in it on the Shriver and Blair farms, near the Pennsylvania line, below Andy Postoffice, and some gas wells on

the Core, Moore, McCord and other lands in the vicinity of Mooresville, Clay district. The following records in the southern edge of Monongalia county will show the relationship of this deep oil sand to the rocks above:

A. Conaway Well, No. 14. Authority, South Penn Oil Company, Clay district, Monongalia county, West Virginia.

	Feet.		Feet.	
Pittsburg Coal	908	to	917	(Steel line.)
Dunkard Sand	1415	"	1475	
Gas Sand	1720	"	1760	
Salt Sand	1800	"	1920	
Big Lime	2160	"	2230	
Big Injun Sand	2230	"	2445	
"Fifty-foot" Sand	2850	"	2930	
Gas at	3303			
Bayard Sand	3323½			(Steel line.)
Oil at	3324			
Total depth	3342			

(One hundred and twenty-five barrel well.)

A. Darrah Well, No. 7.

	Feet.		Feet.
Pittsburg Coal	1095	to	1104
Dunkard Sand	1585	"	1645
Salt Sand (water 2111′)	1945	"	2131
Big Lime	2335	"	2395
Pencil cave	2327	"	2335
Big Injun	2395	"	2575
Fourth Sand	3305		
Fifth Sand	3355	"	3400
Bayard Sand	3505		
First Pay (25 bbls. daily)	3507		
Total depth	3525		

The W. W. Kennedy Well, No. 3, about four miles north from Amos, in Clay district, exhibited the following succession, according to the South Penn Oil Company:

W. W. Kennedy Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	714	to	721
Dunkard Sand	1200	"	1250
Salt Sand	1510	"	1735
Big Injun Sand (salt water and scum of oil)	2034	"	2218
"Fifty-foot" Sand	2600	"	2640
"Thirty-foot" Sand	2700	"	2800

	Feet.	Feet.
Fourth Sand (shells and slate)	2934	
Bayard Sand (showed some pebbles and small show of oil)	3133	" 3134
Total depth	3174	

Remarks:

"Drilled through pay which showed pebble and slate with black oily scum on top of washings at depth of 3133 feet i. e., 2419 feet below the Pittsburg coal. Did not show any hard shell or gas at depth of 3164 feet. Quickly blew out."

S. J. Harvey Well, No. 4.

Fairview district. Authority, South Penn Oil Company.

	Feet.	Feet.
Conductor		14
Pittsburg Coal	1145	
Big Injun Sand	2477	to 2627
"Fifty-foot" Sand	3087	" 3147
Stray Sand	3340	" 3360
Fourth Sand (First pay 3362')	3361	
Fifth Sand (First pay 3400')	3398	
Completed at		3408½

This is the only well in the Fairview region which produces oil from the horizon of the Fifth, or McDonald, Sand.

Probably the deepest productive oil well ever drilled anywhere in the world is that of the Wilson Heirs' No. 9, two miles north from Amos Postoffice. It was drilled by the South Penn Oil Company, and gave the following succession, according to Mr. P. B. Gregory, District Superintendent:

Wilson Heirs' Well, No. 9.

Clay district, Monongalia county, West Virginia. Authority, South Penn Oil Company:

	Feet.	Feet.
Pittsburg Coal	1218	
Big Lime	2455	
Big Injun Sand	2535	to 2690
Oil, gas and water	2632	
"Fifty-foot" Sand	3118	to 3178
Show oil	3122	
"Thirty-foot" Sand	3270	" 3305
Fourth Sand	3440	
Fifth Sand (McDonald)	3495	" 3530
Bayard Sand	3616	
Oil at	3618	
Total depth	3631	

(Twenty-barrel well.)

The oil companies operating in this region, with the exception of the Fisher Oil Company, all designate the deep producing sand of these two records, 2400 feet under the Pittsburg coal, as the "Fifth Sand," which is clearly erroneous, since the Fifth Sand is found at its proper horizon 100 feet higher in the record just given, while above it at the proper intervals come the *Fourth*, or Flat Run "Gordon," and other sands in their proper order and succession, so that there can be no doubt about the identity with the Bayard of the deep producing oil sand in the Amos region of Marion county.

Miracle Run puts into Dunkard creek about two miles above Blacksville, and what is known as the Campbells Run oil belt extends along the waters of the right branch of that stream, from the Marion county line, northeastward into Pennsylvania, crossing Dunkard creek near the mouth of Hoover's run. This oil belt lies about two to two and one-half miles west from the "Flat Run" belt, and like the latter, received its name from a stream in Marion county, just south from the Monongalia county line.

In the Marion county end of the belt on Campbells run the productive oil sand lies only 2150 to 2160 feet below the Pittsburg coal, but northeastward on Miracle run, in Monongalia, the productive horizon shifts down to 2210 to 2225 feet below the Pittsburg coal, and is, therefore, in the same sand as the Flat Run belt, which has been identified in this report with the "Fourth Sand" of the Pennsylvania or Venango Group, while the Campbells Run Sand proper, at 2160 feet below the Pittsburg coal, would most probably represent the bottom portion of the regular Gordon Sand of Washington county, Pennsylvania, since with its "Stray" member immediately above, that sand is often 60 to 75 feet thick.

The following record of the Sarah E. Eddy Well, No. 1, near the village of Cross Roads, on Miracle run, given me by the owner, Hon. Joseph H. McDermott, will show the succession there:

Sarah E. Eddy Well, No. 1.

	Feet.		Feet.
Conductor	29	to	29

Unrecorded (cased 10-inch at 192 feet)	621	"	650
Bluff Sand (Waynesburg)	...	"	...
Unrecorded	232	"	882
Mapletown Coal (Sewickley)	...	"	...
Unrecorded	92	"	974
Pittsburg Coal	...	"	...
Unrecorded (cased $8\frac{1}{4}$" at 1468')	576	"	1550
Sand	90	"	1640
Unrecorded	40	"	1680
"Gas" Sand	110	"	1790
Unrecorded	85	"	1875
Salt Sand	150	"	2025
Unrecorded	160	"	2185
Pencil cave	10	"	2195
Big Lime (cased $6\frac{5}{8}$-inch at 2244')	51	"	2246
Big Injun Sand (little gas at 2281; gas water and oil at 2350')	144	"	2390
Unrecorded	360	"	2750
Sand (Berea)	40	"	2790
Unrecorded	53	"	2843
"Fifty-foot" Sand (shelly break; 133 feet of 5 3-16-inch casing)	266	"	3109
Unrecorded	16	"	3125
Campbells Run Sand (heavy gas at 3125) (Gordon) shells and hard sand	67	"	3192
Fourth Sand (oil show at 3196; well commenced spraying at 3199)	...	"	....

Production first 24 hours, 260 barrels.
Production second 24 hours, 360 barrels.

Other wells drilled to the Fourth Sand, northeast from the Sarah Eddy farm along Miracle run exhibt the succession given in the following records:

Rufus Bell Well, No. 1, on the farm of Rufus Bell in Battelle district, Monongalia county. Well owned by the Battelle Oil Company. Authority, H. & W. L. Shaffer, Contractors.

	Feet.		Feet.
Conductor, 13-inch	15	to	15
Cased 10-inch at			216
Unrecorded to			350
Bluff Sand (Waynesburg)	50	"	400
Unrecorded	312	"	712
Mapletown Coal	8	"	720
Unrecorded	84	"	804
Pittsburg Coal	8	"	812
Unrecorded	353	"	1165
Little Dunkard Sand	15	"	1180

Unrecorded	120	"	1300
Sand (cased 8″ at 1305′)	80	"	1380
Unrecorded	270	"	1650
Salt Sand	150	"	1800
Unrecorded	220	"	2020
Big Lime	60	"	2080
Big Injun Sand (water at 2170′)	235	"	2315
Unrecorded	285	"	2600
Sand (Berea)	40	"	2640
Unrecorded	90	"	2730
Gantz Sand (gas)	15	"	2745
Unrecorded	5	"	2750
Fifty-foot Sand	85	"	2835
Unrecorded	95	"	2930
Campbells Run Sand (Gordon)	30	"	2960
Unrecorded	40	"	3000
Sand, gas on top	30	"	3030
Unrecorded	10	"	3040
Fourth Sand (oil at 3062′)	30	"	3070
Total depth			3086

Rufus Bell Well, No. 2. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	742		
Big Injun Sand	1991	to	2230
"Fifty-foot" Sand	2667	"	2755
Campbells Run Sand (Gordon)	2877	"	2901
Fourth Sand, pay	2980		
Total depth	3001		

Milo Strosnider Well, No. 1. Authority, Battelle Oil Company.

	Feet.		Feet.
Conductor	16	to	16
Unrecorded (cased 10″ at 225′)	284	"	300
Bluff Sand (Waynesburg)	50	"	350
Unrecorded	262	"	612
Mapletown Coal	8	"	620
Unrecorded	92	"	712
Pittsburg Coal	10	"	722
Unrecorded	478	"	1200
Dunkard Sand (cased 8″ at 1210′)	75	"	1275
Unrecorded	175	"	1450
"Gas" Sand	45	"	1495
Unrecorded	55	"	1550
Salt Sand	150	"	1700
Unrecorded (cased 6⅝″ at 1728′)	215	"	1915
Big Lime	65	"	1980

Big Injun Sand (cased 5 3-16″ at 2140′)	200	"	2180
Unrecorded	335	"	2515
Sand (Berea)	40	"	2555
Unrecorded	50	"	2605
Gantz Sand	15	"	2620
Unrecorded	10	"	2630
Fifty-foot Sand	85	"	2715
Unrecorded	175	"	2890
Campbells Run Sand	30	"	2920
Unrecorded	5	"	2925
Sand	10	"	2935
Unrecorded	29	"	2964
Fourth Sand	16	"	2980
Unrecorded	13	"	2993
Sand	15	"	3008
Unrecorded to bottom	151	"	3159

The sand struck at 335 feet below the Big Injun Sand, or 2515 feet in this well is wrongly termed the "Thirty-foot" Sand by many of the drillers in this field, since the true "Thirty-foot" Sand belongs in the interval between the "Fifty-foot" Sand and the Campbells Run Sand. The sand above referred to is most probably identical with the Berea Sand of the Ohio series, if this latter is not the equivalent of either the Gantz or "Fifty-foot" sands of West Virginia.

The record of a well drilled on the Ewing heirs' farm in this Campbells run oil belt, was kept for the writer with much detail through the *Venango Group* by Mr. Joseph W. Craig, President of the Chartiers Oil Company, the owner of the well. It exhibits the following succession down to the *Campbells Run Oil Sand.*

Ewing Heirs' Well, No. 1.

On the farm of the heirs of John H. Ewing, in Battelle district, Monongalia county.

	Feet.	Feet.
Mapletown Coal (Sewickley) at		835
Pittsburg Coal at		924
(10-inch casing at 934 feet.)		
Top of first **Red** at		1060
Top of second **Red** at		1150
Dunkard Sand at		1350
(8¼-inch casing at 1538 feet.)		
Gas Sand (water at 1745) at		1700
Top **Salt Sand** at		1820
Bottom **Salt Sand** (water at 1890′) at		1934
(6⅝-inch casing at 1995.)		

Top "**Big Lime**" at			2130
Top of "**Big Injun**" at			2200
(Gas and a little water at 2280 feet; 5 3-16-inch casing 2360'.)			
Top of **Gantz Sand** (steel line measurement) at			2830
(Little gas at 2848; big gas at 2870.)			
Bottom of "**Fifty-foot**" **Sand**			2945
Slate, pink	2	to	2947
Hard shell, pink	10	"	2957
Soft shell, red	2	"	2959
Hard sand, red	5	"	2964
Soft slate, red	5	"	2969
"Thirty-foot" Sand { sand, hard, gray	30	"	2999
"Thirty-foot" Sand { sand, hard, white	2	"	3001
"Thirty-foot" Sand { sand, hard, blue	25	"	3026
Soft slate, black	5	"	3031
Hard sand, pink	36	"	3067
Soft sand, pink	4	"	3071
Slate, black	2	"	3073
"Liner" (steel measurement)			3072
Shells	5	"	3077
Red shale	13	"	3090
Top **Campbells Run Sand** (oil at 3098 feet)		"	....

This record shows that the true horizon of the "Thirty-foot" Sand of the Venango Group lies in the midst of the *red beds* which intervene between the bottom of the "Hundred-foot" (Gantz and "Fifty-foot") Sand and the Campbells Run or Gordon Sand.

Near the West Virginia-Pennsylvania State line, a short distance south from the mouth of Hoovers run, the South Penn Oil Company reports the following succession on the land of Georgia Eddy:

Georgia Eddy Well, No. 1, Monongalia county.

Pittsburg Coal	965		
Big Injun Sand (oil and gas 2263')	2222	to	2465
"Fifty-foot" Sand	2915	"	2945
Fourth Sand	3180	"	3243
First Pay	3230		
Total depth	3243		

About one mile west from the Campbells Run oil belt, and two miles south from Wadestown, Monongalia county, a well was drilled upon the land of M. J. Garrison by Messrs. Courtney & McDermott, from whom the following record was obtained:

M. J. Garrison Well, No. 1.

	Feet.		Feet.
Conductor	12	to	12
Unrecorded (cased 10-inch at 175 feet)	458	"	470
Bluff Sand (Waynesburg)	40	"	510
Unrecorded	385	"	895
Pittsburg Coal	11	"	906
Unrecorded	479	"	1385
Dunkard Sand (cased 8-inch at 1427 feet)	70	"	1455
Unrecorded	110	"	1565
"Gas" Sand	120	"	1685
Unrecorded	155	"	1840
Salt Sand	50	"	1890
Unrecorded	190	"	2080
Big Lime (cased 6½-inch at 2128 feet)	65	"	2145
Big Injun Sand (water and a little gas at 2240′)	175	"	2320
Unrecorded (cased 5-inch at 2350)	320	"	2640
Sand (Berea)	40	"	2680
Unrecorded	85	"	2765
Gantz Sand	10	"	2775
Unrecorded	5	"	2780
"Fifty-foot" Sand	110	"	2890
Unrecorded	130	"	3020
"Thirty-foot" Sand	30	"	3050
Unrecorded	50	"	3100
Gordon Sand	20	"	3120
Unrecorded	10	"	3130
Fourth Sand (gas at 3145′)	35	"	3165
Unrecorded	42	"	3217
Fifth Sand (a little gas)	3	"	3220
Total depth			3354

Near St. Leo, Battelle district, Monongalia county, some fair oil producers have been found in the Campbells Run Sand. The first well in that region was drilled by the Chartiers Oil Company, and it exhibited the following succession, according to Mr. Jos. W. Craig:

J. M. Hall Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	916		
Dunkard (Mahoning) Sand	1410	to	1430
"Gas" Sand, hard	1600	"	1690
Salt Sand	1816	"	1935
"Big" Lime	2150	"	2228
Big Injun Sand (water 2312′)	2228	"	2415
"Fifty-foot" Sand	2875	"	2925
Campbells Run Sand	3072	"	3107

Oil at	3077		
Fourth Sand	3145	"	3155

As heretofore stated, the Campbells Run Sand is most probably the bottom portion of the true Gordon Sand horizon, and the same as that called "Gordon" by the oil fraternity in Wetzel county, while here in Monongalia and the adjoining county of Marion, the term "Gordon" is generally given to the sand next below the Campbells Run horizon, or the one which the writer has designated as the *Fourth Sand,* 70 to 75 feet below the former.

The record of a boring made on the Haught heirs' farm, two miles west from St. Leo, Monongalia county, was kindly furnished the Survey by Mr. O. D. Harrington of the Fisher Oil Company, Pittsburg, Pa., as follows:

Haught Heirs' Well, No. 1.

	Feet.		Feet.	
Pittsburg Coal	1070			
Dunkard Sand	1580	to	1616	
Salt Sand	2010	"	2110	
Big Injun Sand	2380	"	2580	
Fifty-foot Sand	3000	"	3145	(Oil at 3015 ft.)
Campbells Run (Gordon Sand)	3256	"	3286	
Fourth Sand	3296	"	3310	
Fifth Sand	3340	"	3390	
Bayard Sand	3476	"	3486	(Oil at 3480 ft.)

10″ Casing, 408 feet.
8¼″ Casing, 1490 feet.
6⅝″ Casing, 2541 feet.

The presence of the *Bayard Sand* here at its proper horizon (2400 feet) below the Pittsburg coal, and holding some oil, should lead to the drilling of more test wells to this sand in western Monongalia.

About three miles west from Wadestown, Battelle district, and within two miles of the Wetzel-Monongalia line, the Fort Pitt Gas Company drilled a test well on the land of R. S. Clovis, the record of which is as follows, according to Jos. W. Craig:

R. S. Clovis Well, No. 1.

	Feet.		Feet.
Pittsburg Coal			810
Caving places	900	to	1200

Dunkard Sand	1340	"	1370
Gas Sand	1540	"	1680
Salt Sand	1730	"	1830
Pencil cave	2005	"	2020
Big Lime	2020	"	2075
Big Injun Sand (gas 2160′)	2075	"	2310
Slate, sand and shells	2310	"	2805
"Fifty-foot" Sand	2810	"	2840
Sand	2850	"	2870
Sand ("Thirty-foot")	2905	"	2925
Sand ("Gordon Stray")	2935	"	2950
Sand, Gordon (Campbells Run)	2955	"	2975
Sand	3015	"	3025
Fourth Sand	3050	"	3065
Fifth Sand	3075	"	3093
Slate and lime	3093	"	3432
Total depth of well	3432		

The Bayard Sand horizon appears not to have been noted in the Clovis well.

William Porter Well, No. 1.

Battelle district. Authority, Carnegie Natural Gas Company.

	Feet.		Feet.
Unrecorded to top of Pittsburg Coal at	900	to	900
Unrecorded	1300	"	2200
Big Injun Sand	236	"	2436
Unrecorded	419	"	2855
"Fifty-foot" Sand	20	"	2875
Unrecorded	310	"	3185
Fifth Sand { Sand 15′; Unrecorded 14′; Sand 26′ }	45	"	3230
Unrecorded	111	"	3341
Sixth, or Bayard, Sand (little gas)	6	"	3347
Total depth (slate)	173	"	3520

James Hagan Well, No. 1.

Battelle district. Authority, Carnegie Natural Gas Company.

	Feet.		Feet.
Unrecorded to top of Pittsburg Coal	717	to	717
Unrecorded	903	"	1620
Salt Sand	150	"	1770
Unrecorded	168	"	1938
Big Lime	75	"	2013
Big Injun Sand	125	"	2238
Unrecorded	390	"	2628
Cantz Sand (little gas at 2645′)	18	"	2646
Unrecorded	19	"	2665
"Fifty-foot" Sand	73	"	2738

Unrecorded	185	"	2923
Fourth Sand	16	"	2939
Unrecorded	3	"	2942
Fourth Sand	12	"	2954
Unrecorded	27	"	2981
Fifth Sand	29	"	3010
No Bayard Sand.			
Total depth			3264

Record of the S. L. S. Spragg Well, No. 1.

One-fourth mile northeast of St. Cloud. Authority, J. P. Hagan, of the Syndicate Oil and Gas Company:

	Feet.		Feet.
Bluff (Waynesburg) Sand	578		
Mapletown (Sewickley) Coal	832	to	835
Pittsburg Coal	929	"	935
Dunkard Sand	1445	"	1570
Sand "Gas")	1605	"	1675
Salt Sand (water at 1900′)	1883	"	1925
Pencil cave	2115	"	2124
Big Lime	2124	"	2184
Big Injun Sand (gas at 2200′)	2184	"	2404
Fifty-foot Sand	2822	"	2902
"Nineveh" Sand (pebbly at top) ("Thirty-foot")	2953	"	2988
Red rock	3005	"	3025
Gordon Sand (Campbells Run) (show oil at 3107′)	3095	"	3120
Fourth Sand	3155	"	3170
Fifth Sand	3195	"	3207
Slate and shells (completed in slate)	3207	"	3406

10″ Casing, 206 feet.
8″ Casing, 1424 feet.
6⅝″ Casing, 2150 feet.

RECORDS IN MARION COUNTY.

Marion county lies next south from Monongalia, and has proven very rich in both oil and gas. A very large number of wells have been drilled within this county, and we shall now give a series of these records, proceeding from east to west.

A well was drilled by the Hope Natural Gas Company on the Jones farm, Winfield district, two miles east from the Monongahela river, near White Day Postoffice, from which the following succession is reported:

Brent S. Jones Well, No. 1.

	Feet.		Feet.
Conductor	0	to	14
"Creek" sandstone	14	"	23
Slate	23	"	40
White sandstone (Mahoning)	40	"	80
Coal and water (U. Freeport)	80	"	83
Slate and lime	83	"	170
Slate and Coal (U. Kittanning)	170	"	185
Sand and lime	185	"	242
Kitanning Coal	242	"	247
Hard lime	247	"	270
White sandstone and water (top of Pottsville)	270	"	285
Slate	285	"	295
Lime and sand	295	"	410
Slate	410	"	415
Sandy lime	415	"	440
Black slate	440	"	510
Sand shells	510	"	525
Black slate	525	"	540
White slate	540	"	570
Red rock	570	"	585
Slate	585	"	600
White sandstone	600	"	625
Lime	625	"	540
Red rock	640	"	655
Lime	655	"	755
Slate	755	"	760
Red rock	760	"	775
Big Lime	755	"	845
Big Injun, very hard	845	"	860
" " red	860	"	875
" " gas and water	875	"	950
" " very hard	950	"	990
" " slate break	990	"	1000
" " sand	1000	"	1130
Slate	1130	"	1140
Sand, very hard	1140	"	1180
Slate and lime shells	1180	"	1260
Hard lime	1260	"	1285
Slate	1285	"	1320
Slate and hard shells	1320	"	1410
White sandstone. (Gantz) and "50-ft."	1410	"	1505
Slate and shells.	1505	"	1535
White sandstone..	1535	"	1570
Red rock	1570	"	1595
Sand	1595	"	1615
Slate	1615	"	1625

Hard shells	1625	"	1635	
Slate and shells	1635	"	1690	
Sandy shells	1690	"	1700	
Red rock	1700	"	1775	
Sand shells	1775	"	1785	
Slate	1785	"	1800	
Red sandstone (soft)	1800	"	1840	
Lime	1840	"	1860	
Dark Sand (Bayard)	1860	"	1900	
Slate and shells	1900	"	1953	(Steel line measure.)
Sand (Elizabeth)	1953	"	1990	
Black slate	1990	"	2050	
White slate	2050	"	2350	
Hard lime	2350	"	2515	
White slate	2515	"	2539	
Total depth	2539			

This record reveals the "shelly" and "split-up" condition of the Gordon, Fourth and Fifth Sands. The well begins about 520 feet below the Pittsburg coal, and hence the sands at 1860 and 1953 represent the *Bayard* and *Elizabeth* horizons respectively.

A large gas field has recently been developed northwest from Barrackville, Marion county, by the Fairmont, Fayette, Hope and other Gas companies.

The following record of the Eli M. Rex Well, No. 1, drilled by the Hope Natural Gas Company will give the succession there.

It is located about three miles north 20° west from Barrackville, and the record reads as follows:

Eli M. Rex Well, No. 1.

	Feet.		Feet.
Conductor	0	to	16
Native Coal (Sewickley)	255	"	260
Pittsburg Coal	365	"	375
Salt Sand	1300		
Little Lime	1585	"	1610
Pencil cave	1610	"	1615
Big Lime	1615	"	1735
Big Injun Sand	1735	"	1840
Very light gas at	1755		
Slate and shells to	1900		
Sand (Squaw)	1900	"	1925
Slate to	1940		
Lime to	1950		
Slate to	1980		
Sand	2010		

White lime	2050		
Sand	2075		
Slate	2090		
Lime	2110		
Slate	2120		
Lime	2135		
Slate	2145		
Sand	2165		
Lime	2180		
Sand	2180	"	2235
Slate	2245		
Lime	2255		
Sand (Gantz)	2275		
Slate	2280		
Sand	2305		
Lime	2310		
Slate	2315		
Lime	2320		
Sand	2330		
Red rock	2335		
Sand	2340		
Slate	2345		
Sand	2405		
Red rock	2410		
Sand	2420		
Red rock	2425		
Sand	2445		
Red rock	2455		
Sand ("Thirty-foot")	2455	"	2480
Red rock	2490		
Sand, lime and shells	2520		
Lime shells	2535		
Sand (Gordon)	2550		
Lime	2560		
Black slate	2570		
Lime	2575		
Red rock	2585		
Lime	2590		
Sand (Fourth)	2600		
Lime	2605		
Slate	2620		
Blue lime	2625		
Black slate	2635		
Lime	2645		
Sand (Fifth)	2655		
Slate	2675		
Lime	2680		
Soft black slate	2695		
Lime to	2721		

Bayard Sand	2721	"	2749
Lime	2755		
Slate	2800		
Lime	2810		
Slate	2873		
Total depth	2873		

The sand struck at 2721 feet, 2356 feet below the Pittsburg coal, has been termed the Fifth Sand by the driller, but it is evidently equivalent to the Bayard.

Near the headwaters of Dunkard Mill run, which puts into Buffalo creek between Barrackville and Farmington, Marion county, several large gas wells have been struck, one of which, drilled by the Fayette County Gas Company on the Connor farm, gives the following succession, according to Mr. F. G. Best, District Superintendent:

Connor Well, No. 1.

	Feet.		Feet.
Conductor	21		
Sewickley Coal	245		
Pittsburg Coal	368		
Ten-inch casing	376		
Sand	970	"	1000
"Big" Dunkard Sand	1095	to	1120
"Gas" Sand	1160	"	1205
Salt Sand	1295	"	1400
Cased 8¼-inch	1307		
Big Lime	1630	"	1710
Cased 6⅝-inch	1630		
Big Injun Sand	1710	"	1830
Gantz Sand	2240	"	2260
Fifty-foot Sand	2280	"	2295
Fourth Sand	2575	"	2585
Bayard Sand	2732	"	2752
Finished	2757		
Packer set	2717		

Pressure.

1st	minute	275	6th	minute	825
1½	"	370	7	"	875
2	"	440	8	"	900
3	"	550	9	"	925
4	"	635	10	"	935
5	"	740	15	"	950

The well of the Fayette Company on the Athey farm in this

same region, gave the following succession, according to Mr. F. G. Best:

Athey Well, No. 1.

	Feet.		Feet.	
Conductor	16			
(Sewickley) Mapletown Coal	260			
Pittsburg Coal	357	to	367	
Cased 10-inch			370	
Little Dunkard Sand	968	"	1002	
"Big" Dunkard Sand	1090	"	1115	
"Gas" Sand	1158	"	1200	
Salt Sand (8¼″ casing 1310′)	1290	"	1395	(water)
Maxton Sand	1478	"	1496	
Little Lime	1618	"	1628	
Big Lime (Cased 6⅝″ 1697′)	1634	"	1714	
Big Injun Sand	1718	"	1805	
Gas at			1770	
Sand	1809	"	1830	
Sand (Squaw)	1900	"	1930	
Gantz Sand	2205	"	2235	
Fourth Sand	2560	"	2580	
Fifth Sand	2605	"	2612	
Bayard Sand (gas)	2730			
Finished	2750			

Pressure.

1st minute	200 pounds	16th minute	1060 pounds
2nd minute	350 pounds	Rock pressure	1100 pounds

The original "rock pressure" in the Bayard Sand of this region was 1100 pounds, the same as on the Thomas Bayard farm, near Waynesburg.

A well drilled on the E. W. Hamilton farm, Plum run, three to four miles east from Mannington, by the Hope Natural Gas Company shows the following results, according to the driller's log:

E. W. Hamilton Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	600		
Little Dunkard Sand	1020	to	1035
Big Dunkard Sand	1080	"	1140
Gas Sand	1410	"	1480
Salt Sand	1520	"	1600
Big Lime	1870	"	1937
Big Injun Sand (gas 2029′)	1937	"	2067
"Fifty-foot" Sand (gas 2530′)	2515	"	2659
"Stray" and Gordon Sands	2665	"	2745

Fourth Sand (gas 2850′)	2835	"	2890
Bayard Sand (gas 3020′)	2990		
Total depth	3025		

The gas in this well was obtained at 2420 feet below the Pittsburg coal, and is undoubtedly from the Bayard Sand, although called the "Fifth" in the driller's log and on the books of the Hope Company.

Two miles south from Fairview (Amos Postoffice), the Fisher Oil Company reports the following succession in the Brown gas well:

G. W. Brown Well, No. 1.

	Feet.		Feet.
Conductor	12		
Pittsburg Coal	464		
Big Injun Sand (gas at) top pay			1892
Fifty-foot Sand	2365	to	2410
Fourth Sand	2685		
Little gas	2687		
Bayard Sand (gas)	2838		
Total depth	2929		
Ten-inch casing	480		
Eight and one-fourth-inch casing	964		
Six and five-eights-inch casing	1470		
Five and three-sixteenths-inch casing	1970		

The following records are from near Fairview or Amos, Marion county, where the Fisher Oil Company first developed good producing wells in the Bayard Sand by drilling down a well which had been productive in the Big Injun Sand:

P. B. Amos Well, No. 11.

	Feet.		Feet.
Pittsburg Coal	602		
Dunkard Sand	1110	to	1154
Salt Sand (water 1480′)	1400	"	1610
Maxton Sand	1680	"	1700
Pencil cave	1830	"	1840
Big Lime	1840	"	1910
Big Injun Sand	1910	"	2210
"Fifty-foot" Sand	2530		
"Stray"	2810		
Fourth Sand	2840		
Bayard Sand	3008		
Best pay (production 75 bbls. daily)	3009		
Total depth	3028		

A. Conaway Well, No. 15.

One mile and a half north of Amos. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	893	to	903
Dunkard Sand	1394		
"Gas" Sand	1550		
Salt Sand	1781		
Big Lime	2126		
Pencil cave	2114		
Big Injun	2196	"	2359
First pay (just a small show of oil)	2291		
"Fifty-foot' Sand	2806		
Fourth Sand	3098		
Bayard Sand (gas enough to run boiler, 3293')	3293	"	3323
Oil (production 25 barrels daily)			3315
Total depth			3333½

J. P. Yost Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	600		
Dunkard Sand	1100	to	1170
Salt Sand	1450	"	1500
Pencil cave	1830		
Big Lime	1840	"	1900
Big Injun (small show oil 2005')	1910	"	2060
"Thirty-foot" Sand (Berea?)	2385	"	2415
"Fifty-foot" Sand	2520	"	2575
"Stray"	2785	"	2805
Fourth Sand	2845	"	2870
Bayard Sand (small gas, 3020')	3015		

M. E. Brookover Well, No. 4.

	Feet.		Feet.
Pittsburg Coal	702		
Dunkard Sand	1200		
Salt Sand	1500		
Big Lime	1930		
Big Injun Sand (oil and water 2130')	2000	to	2140
"Thirty-foot" (Berea?)	2500		
"Fifty-foot" Sand	2500		
Fourth Sand	2930		
Bayard Sand (production 200 bbls daily)	3125		
Total depth	3135		

This well came in with a production of 200 barrels daily in July, 1903, and is still yielding (June 5, 1904) 68 barrels, thus

illustrating the remarkable "staying" qualities of the Bayard Sand oil production.

Just below Mannington, the Burt Oil Company drilled several wells on the old Burt farm, the producing sand being the "Big Injun." The Pitsburg coal lies about 400 feet below the valley.

Burt No. 2 gave the following record, according to the Burt Oil Company's books:

Burt Well, No. 2.

	Feet.
Pittsburg Coal, bottom	441
Big Injun Sand	1778
First "Pay"	1853
Second "Pay"	1860
Total depth	1877

Burt well No. 14, near Mannington, was the first well in that field to be drilled to the deep sands. Its record reads as follows:

	Feet.		Feet.
Pittsburg Coal	510		
Big Injun Sand	1838		
First pay	1914		
Second pay	1924		
Fourth Sand (oil 2728′)	2723	to	2742
Dark slate, soft	2742	"	2762
Fifth Sand	2762	"	2788
Slate, dark to bottom	2788	"	3000

This sand, at 2723 feet, was termed the "Gordon" Sand when first struck on the Burt farm, and the oil fraternity has ever since given that name ("Gordon") to this sand, which, in the Mannington region, lies 2200 to 2220 feet below the Pittsburg coal, and which, on Whetstone run, two miles southwest from Mannington, furnished wells which produced over 3000 barrels daily.

The following record of Furbee Well No. 1, located in Mannington, is given on the authority of the Burt Oil Company:

Furbee Well, No. 1

	Feet.		Feet.
Pittsburg Coal	400		
Limestone	450	to	470
Slate	490		
Gas	500		
Red rock	620		

Dunkard Sand	956		
Salt Sand	1350	"	1450
Big Injun Sand (oil 1840)	1752	"	1873
Fourth Sand (oil 2621')	2621		
Total depth	2631		

About two miles west from Mannington the Burt Oil Company drilled two wells on the "Paddy" Hopkins lot in what has been termed the Hafer pool. The records of these wells read as follows:

Paddy Hopkins Well, No. 1.

	Feet.
Pittsburg Coal	464
"Got some gas in Gantz Sand," also in the "Fifty-foot"	...
First pay (Fourth Sand)	2683
Second pay (mostly gas)	2687
Ten-inch Casing	386
Eight and one-fourth-inch Casing	1020
Six and five-eights-inch Casing	1539
Five and three-sixteenths-inch Casing	1965

Paddy Hopkins Well, No. 2.

	Feet.	Inches.
Pittsburg Coal, bottom	471	
Stray Sand, bottom	2668	
Fourth Sand	2678	6
First pay	2687	6
Ten-inch Casing	220	
Eight and one-fourth-inch Casing	1000	
Six and five-eighths-inch Casing	1486	
Five and three-sixteenths-inch Casing	1970	

Flat run puts into Buffalo creek about two miles above Mannington, and along it many oil wells have been drilled, in fact, this productive belt which extends from Buffalo creek in Marion northwestward almost across Monongalia, received its name "Flat Run Oil Belt" from the stream in question. The producing sand is the Fourth, as will be seen by the two following records obtained from the Hartman Oil Company:

William O. Efaw Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	1003		
Dunkard Sand	1520	to	1570
"Gas" Sand	1678	"	1788
Salt Sand	1890	"	1945
Pencil cave	2221		

Big Injun Sand	2275	"	2435
Berea Grit	2800	"	2900
Gantz Sand (gas. 2910′)	2905	"	2930
"Fifty-foot" Sand	2950	"	3050
Fourth Sand	3198	"	3228
First oil	3218		
Second oil	3222		
Ten-inch Casing	305		
Eight and one-fourth-inch Casing	1440		
Six and five-eighths-inch Casing	2100		
Five and three-sixteenths-inch Casing	2440		
Four-inch Liner	300		

Wm. O. Efaw Well, No. 6.

Flat run, Marion county. Near Monongalia county line.

	Feet.		Feet.
Pittsburg Coal	1150		
Dunkard Sand	1645	to	1740
Gas Sand	1885	"	1955
Salt Sand	2065	"	2100
Big Injun Sand (gas, 2540′)	2460	"	2630
"Thirty-foot" Sand (Berea)	2850	"	2870
Gantz Sand	3040	"	3045
"Fifty-foot" Sand (gas, 3075)	3070		
Fourth Sand (oil, 3364-3375′)	3360	"	3380
Total depth	3380		
Eight ond one-fourth-inch Casing	1661		
Six and five-enghths-inch Casing	2630		
Five and three-sixteenths-inch Liner	225		

At the head of Whetstone run, three miles southwest from Mannington, the Hartman Oil Company found the following succession in well No. 1 of the Hess & Tetrick lands:

Hess & Tetrick Well, No. 1.

	Feet.		Feet.	In.
Pittsburg Coal	692			
Big Injun Sand	2054	to	2155	
Gantz Sand	2606	"	2637	
"Fifty-foot" Sand	2641			
Fourth Sand (gas)	2886	"	2903	6

The same (Hartman) Company drilled some wells on the Farrell heirs' farm, Mannington district, and No. 1 thereon gave the following succession:

Farrell Heirs' Well, No. 1.

	Feet.	Feet.
Pittsburg Coal	828	
Dunkard Sand	1320	

"Gas" Sand	1580		
Pencil cave	2075		
Big Lime	2085		
Big Injun Sand	2141	to	2340
(Gas, 2160'; oil, 2245'.)			
"Fifty-foot" Sand	2770		
"Thirty-foot" Sand	2890		
"Stray" Sand	2970		
Fourth Sand (gas, 3011; oil, 3012')	3007	"	3020

The sand called "Gordon Stray" by the drillers is most probably the equivalent of the Campbells Run Sand.

The records of the Hartman Oil Company for the John Shanks wells Nos. 4 and 5, near Mannington, read as follows:

John Shanks Well, No. 4.

	Feet.		Feet.
Pittsburg Coal	487		
Dunkard Sand	998	to	1033
Salt Sand	1390	"	1528
Big Injun Sand	1780	"	1952
Gantz Sand	2412	"	2437
"Fifty-foot" Sand	2440	"	2482
Fourth Sand	2710	"	2720

John Shanks Well, No. 5.

	Feet.		Feet.
Bluff Sand	250	to	325
Mapletown Coal	445		
Pittsburg Coal	549		
"Gas" Sand	1210		
Salt Sand	1445	"	1580
Big Injun Sand (gas, 1862')	1856	"	1995
"Thirty-foot" (Berea) Sand	2370	"	2395
Gantz Sand	2480	"	2490
"Fifty-foot" Sand	2495	"	2355
Fourth Sand	2772½		
Oil at	2784		

J. H. Furbee Well, No. 2.

Near Mannington, Marion county. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	744		
Dunkard Sand	1290	to	1335
"Gas" Sand	1420	"	1535
Salt Sand	1640	"	1700
Big Injun Sand	2085	"	2200
Gantz Sand	2670	"	2690
"Fifty-foot" Sand	2705	"	2765

"Thirty-foot" Sand	2844	"	2865
"Stray" (Campbells Run) Sand	2900	"	2930
Fourth Sand (oil, 2964')	2959	"	2984

Ten-inch casing, 345'; 8¼" casing, 1295'; 6⅝" casing, 1755'; 5 3-16" casing, 2225'.

In the previous record the driller has termed a sand the "Thirty-foot" which occurs over 100 feet *above* the "Fifty-foot horizon, and then in the Furbee No. 2 he has given the same name to a sand nearly 100 feet *below* the "Fifty-foot" Sand. The latter is the correct interpretation, as may be seen from the type records quoted from Carll in his Butler county, Pa., records, as given on previous pages of this volume, and hence the use of the term "Thirty-foot" for a sand at about 1,750 to 1,800 feet below the Pittsburg Coal is erroneous, since this horizon is probably identical with the Berea Grit of other regions.

The Hartman Oil Company has drilled several wells on the Nimrod Morgan farm, along the B. & O. R. R., two or three miles above Mannington, the records of which read as follows:

Nimrod Morgan Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	525		
"Gas" Sand	1175		
Salt Sand	1422		
Big Injun Sand (gas, 1850')	1838		
"Fifty-foot" Sand	2448	to	2528
"Thirty-foot" Sand	2548		
"Stray" Sand	2700		
Fourth Sand (first pay)	2745		

Gas, big, at 2710'; gas at 2750'; gas at 2755'.

Ten-inch casing, 463'; 8½" casing, 1100'; 6¼" casing, 1522'; 5 3-16" casing, 2000'.

N. Morgan Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	630		
Salt Sand	1540	to	1560
Big Injun Sand	1930		
"Fifty-foot" Sand	2565		
"Stray" Sand	2804		
Fourth Sand	2857		
Total depth	2879		

N. Morgan Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	458		
Little Dunkard Sand	850		

	Feet.		Feet.
Big Dunkard Sand	1100	to	1145
"Gas" Sand	1200	"	1325
Salt Sand	1355	"	1490
Big Injun Sand	1800	"	1945
Sand (Berea)	2330	"	2360
Gantz Sand	2385	"	2397
"Fifty-foot" Sand	2405	"	2490
Fourth Sand (oil, 2683′)	2675	"	2700

Nimrod Morgan Well, No. 5.

	Feet.		Feet.
Pittsburg Coal	462		
Little Dunkard Sand	840	to	865
Dunkard Sand	990	"	1005
"Gas" Sand	1089	"	1120
Salt Sand	1372	"	1540
Big Injun Sand	1780	"	1912
Sand (Berea?)	2255	"	2275
Gantz Sand	2400	"	2410
"Fifty-foot" Sand	2415	"	2510
"Stray"	2635	"	2675
Fourth Sand	2681	"	2703
(One pay good sand, 2693-2703.)			

Nimrod Morgan Well, No. 7.

	Feet.		Feet.
Pittsburg Coal	482		
Dunkard Sand	990	to	1020
"Gas" Sand	1105	"	1275
Salt Sand	1375	"	1520
Big Injun Sand (gas at 1905)	1775	"	1920
Sand (Berea?)	2275	"	2295
Gantz Sand	2400	"	2412
"Fifty-foot" Sand	2415	"	2470
"Stray" (Campbells Run) Sand	2645	"	2683
Fourth Sand (oil 2708′)	2699	"	2714
(Good Sand 2707-2714.)			

Ten-inch casing, 496′; 8¼″ casing, 1040′; 6⅝″ casing, 1514′; 5 3-16″ casing, 1980′.

About two miles south from Mannington, the Z. Kendall well, No. 3, gives the following succession, according to the South Penn Oil Company.

Z. Kendall Well, No. 3.

(Steel line measurements.)

	Feet.		Feet.
Mapletown Coal	688	to	695
Pittsburg Coal	779	"	787
Dunkard Sand	1270	"	1360

"Gas" Sand	1390	"	1700
Salt Sand	1730	"	1855
Pencil cave	2060	"	2064
Big Lime	2064	"	2145
Big Injun Sand	2145		
First pay (oil)	2223		
Total depth	2255		

About four miles southwest from Mannington, the P. G. Hall well, No. 3, gives the following record, as reported by the South Penn Oil Company:

P. G. Hall Well, No. 3.

(Steel line.)	Feet.		Feet.
Mapletown Coal	506	to	511
Pittsburg Coal	603	"	612
Dunkard Sand	1033	"	1103
"Gas" Sand	1340	"	1470
Salt Sand	1575	"	1660
Maxton Sand	1710	"	1740
Pencil cave	1842	"	1847
Big Lime	1847	"	1943
Big Injun Sand (oil, 2032')	1943	"	2073
Sand	2493	"	2520
"Fifty-foot" Sand (gas, 2598')	2593	"	2640
Stray (Campbells Run)	2758	"	2775
Fourth Sand (oil, 2787')	2779	"	2807

The Hartman Oil Company has drilled several wells in the western portion of Marion county, some near Glovers Gap, and some near Brink, the records of which are here given:

Lemley & Hibbs Well, No. 1.

One mile east of Glovers Gap.

	Feet.		Feet.
Pittsburg Coal	866		
Big Injun Sand	2206	to	2281
("Break" 5 ft. at 2256-2261')			
Bottom	2284.9		

Lemley & Hibbs Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	921		
Big Injun Sand	2270	to	2337
Bottom			2404½

Lemley & Hibbs Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	841		
Big Injun Sand ("Break," 2237-2251)	2197	to	2263

Rachel Evans Well, No. 1.

One mile east of Brink Postoffice.

	Feet.		Feet.
Pittsburg Coal	1005		
Big Injun Sand	2305	to	2394
"Break," Slate	2394	"	2409
"Squaw" Sand	2409	"	2448
Sand	3070	"	3175
Slate	3175	"	3241
Bottom			3345½

J. W. Campbell Well, No. 1.

	Feet.		Feet.
"Bluff" Sand	830	to	955
Pittsburg Coal	1251		
Little Dunkard Sand	1621		
Big Dunkard Sand	1751	"	1800
"Gas" Sand	2062	"	2100
Salt Sand	2188	"	2273
Big Injun Sand	2524½	"	2649½

The South Penn Oil Company has drilled very many wells in Marion county, and the following records are given upon the authority of that Company's books:

Aaron Furbee Well, No. 1.

On the farm of Aaron Furbee, near Glovers Gap.

	Feet.		Feet.
Unrecorded to			670
Mapletown Coal	5	to	675
Unrecorded to			767
Pittsburg Coal	7	"	774
Unrecorded to			1268
Dunkard Sand (8¼″ casing 1274′)	77	"	1345
Unrecorded to			1442
"Gas" Sand (water at 1545′)	133	"	1575
Unrecorded to			1698
Salt Sand	12	"	1710
Unrecorded to			2072
Big Injun Sand (gas at 2085′) (6⅝″ casing 2088′) (oil and water at 2175′)	191	"	2263
Unrecorded to			2720
Fifty-foot Sand	35	"	2755
Unrecorded to			2820
Thirty-foot Sand (5 bailers oil)	45	"	2865
Unrecorded to			2908
Stray Sand	24	"	2932
Unrecorded to Gordon Sand (Campbells Run) and oil at			2939

Bottom			2967

Lusetta Snodgrass Well, No. 1.

Near Glover's Gap.

	Feet.		Feet.
Unrecorded to			800
Mapletown Coal	5	to	805
Unrecorded to			895
Pittsburg Coal	10	"	905
Unrecorded to			1415
Dunkard Sand (cased 8¼″ at 1429′)	14	"	1429
Unrecorded to			1700
Salt Sand	15	"	1715
(Balance of Salt Sand represented by slate and shells.)			
Unrecorded to			2130
Big Lime	65	"	2195
Big Injun Sand (cased 6⅝″ 2198′)	140	"	2335
(Water at 2300′; hole filled up 1900′.)			
"Squaw" Sand	55	"	2390
Unrecorded to (cased 5 3-16″ 2424′)			2925
Fifty-foot Sand (show of oil at 2940′)	34	"	2959
Unrecorded to bottom of liner 3067′)			3067
Gordon Sand (Campbells Run)	23	"	3090
Oil at first pay 3068′; second pay 3073′.			
Bottom of well			3090 2-3

E. J. Freeland Well, No. 1.

	Feet.		Feet.
Unrecorded to Pittsburg Coal at (cased 10″ at 410)			1025
Unrecorded to			1535
Dunkard Sand (cased 8¼″ at 1635′)	50	to	1585
Unrecorded to			1704
"Gas" Sand	138	"	1842
Unrecorded to			1952
Salt Sand	78	"	2030
Unrecorded to			2275
Pencil cave	5	"	2280
Limestone, white	62	"	2342
Big Injun Sand (oil at 2458; second oil at 2466)	163	"	2505
Unrecorded to			2835
Sand, Gantz	25	"	2860
Unrecorded to			2963
Fifty-foot Sand (gas at 2978′)	52	"	3015
Unrecorded to			3198
"Stray" Sand (Campbells Run)	24	"	3222
Slate	6	"	3228
Sand (Fourth and Fifth)	71	"	3299

(Slate break 3265 to 3268′) (oil at 3277′)			
Bottom of well			3299

Simon Moore Well, No. 1.

On the farm of Simon Moore, west of Campbells run, in Mannington district, Marion county.

	Feet.		Feet.
Unrecorded to			945
Pittsburg Coal	7	to	952
Unrecorded to			1430
Dunkard Sand	40	"	1470
Unrecorded to			1580
"Gas" Sand	80	"	1660
Unrecorded to			1850
Salt Sand	100	"	1950
Unrecorded to			2200
Pencil cave	6	"	2206
Big Lime	67	"	2273
Break (slate)	6	"	2279
Big Injun Sand	103	"	2382
Unrecorded to			2655
Thirty-foot Sand (Berea)	30	"	2685
Unrecorded to			2845
Gantz Sand	5	"	2850
Unrecorded to			2888
Fifty-foot Sand	46	"	2934
Unrecorded to			3088
"Stray" Sand	12	"	3100
Unrecorded to			3112
Gordon Sand (oil at 3113′) (Campbells Run)	46	"	3158
Unrecorded to			3164
Fourth Sand	16	"	3180
Unrecorded to			3195
Fifth Sand	9	"	3204
Bottom of well			3218

E. Moore's Heirs' Well, No. 1.

Campbells run, Marion county.

	Feet.		Feet.
Conductor			16
Slate and limestone	1074	to	1090
Mapletown Coal	5	"	1095
Limestone	180	"	1175
Pittsburg Coal	10	"	1185
Limestone and red rock (cased 8¼″ at 1662′)	485	"	1670
Dunkard Sand	80	"	1750

Slate and Sand	350	"	2100
Salt Sand	160	"	2260
Slate and limestone (cased 6⅝″ at 2434′)	195	"	2455
Big Lime	65	"	2520
Big Injun Sand (cased 5 3-16″ at 2632′)	140	"	2660
Sand	40	"	2700
Slate and shells	50	"	2750
Limestone and slate	400	"	3150
Fifty-foot Sand	30	"	3180
Sand shells	110	"	3290
Sand	12	"	3302
Shells	10	"	3312
"Stray" Sand	10	"	3322
Slate	8	"	3330
Gordon Sand (Campbells Run)	10	"	3340
First pay			3331
Second pay			3340
Bottom of well			3340

I. E. Arnett Well, No. 1.

Campbells run, Marion county, close to the Monongalia county line.

	Feet.		Feet.
Pittsburg Coal			876
Unrecorded to			1360
Dunkard Sand (cased 8¼″ at 1368′)	30	"	1390
Unrecorded to			1643
"Gas" Sand	27	"	1670
Unrecorded to Salt Sand at			1791
Unrecorded to (cased 6⅝″ 1940′)			2181
Big Injun Sand	170	"	2351
Unrecorded to Thirty-foot Sand (cased 5 3-16″ at 2376′)			2671
Unrecorded to			2810
Gantz Sand	10	"	2820
"Break" (slate)	5	"	2825
Fifty-foot Sand	53	"	2878
Unrecorded to			3005
"Stray" Sand	15	"	3020
Slate (bottom of liner 3035′)	15	"	3035
Gordon Sand	29	"	3064
First pay			3035
Second pay			3053
Bottom of well			3064

Scott Arnett Well, No. 1.

Campbells run, Marion county.

	Feet.	Feet.
Elevation above tide, 1247.		
"Bluff" Sand		650

Unrecorded to Mapletown Coal at			910
Unrecorded to Pittsburg Coal at			1010
Unrecorded to			1505
Dunkard Sand (cased 8¼″ at 1521′).....	75	"	1580
Slate	50	"	1630
Gas Sand (water at 1640′)	130	"	1760
Salt Sand	110	"	1870
Slate	50	"	1920
Red rock and sand shells	180	"	2100
Lime shells	80	"	2180
Limestone and sand	70	"	2250
Big Lime (cased 6⅝″ at 2300′).........	70	"	2320
"Break" (slate)	20	"	2340
Big Injun Sand (water at 2440).........	120	"	2460
Sand, hard	50	"	2510
Shells and hard sand (cased 5 3-16″ at 2539′)	200	"	2710
Slate and sand shells	230	"	2940
Gantz Sand	45	"	2985
Fifty-foot Sand	45	"	3030
Unrecorded to			3159
"Stray" Sand	13	"	3172
Slate	3	"	3175
Gordon Sand (Campbells Run)..........	27	"	3202
First pay			3176
Second pay			3179
Bottom of well			3202

Henry Rice's Heirs' Well, No. 1.

Flat run, Marion county.

	Feet.		Feet.
Unrecorded to			690
"Bluff" Sand	70	to	760
Coal (Waynesburg)	3	"	763
Unrecorded to			770
Sand	46	"	816
Unrecorded to Mapletown Coal at			1034
Unrecorded to			1137
Pittsburg Coal	6	"	1143
Unrecorded to			1650
Dunkard Sand (cased 8¼″ at 1675′)	60	"	1710
Unrecorded to			1828
"Gas" Sand	80	"	1908
Unrecorded to			2000
Salt Sand	74	"	2074
Unrecorded to (cased 6⅝″ at 2187′).....			2342
Pencil cave	6	"	2348
Big Lime	72	"	2420
Big Injun Sand	143	"	2563

Show of oil, 2510′; salt water, 2528′.			
Unrecorded to (cased 5 3-16″ at 2598′)...			2900
Thirty-foot Sand (Berea?)	90	"	2990
Oil at			2997
Unrecorded to			2997
Gantz Sand	11	"	3008
Unrecorded to			3035
Fifty-foot Sand (gas at 3045′)..........	72	"	3107
Unrecorded to			3280
"Stray" Sand (Campbells Run)........	38	"	3318
Unrecorded to			3342
Fourth Sand (oil at 3346′)	24	"	3366
Bottom of well			3374

James Price Well, No. 1.

Flat run, Marion county.

	Feet.		Feet.
Unrecorded to			650
"Bluff" Sand	50	to	700
Unrecorded to			976
Mapletown Coal	8	"	984
Unrecorded to			1054
Pittsburg Coal	6	"	1060
Unrecorded to			1552
Dunkard Sand	58	"	1610
Unrecorded to			1700
"Gas" Sand	80	"	1780
Unrecorded to			1900
Salt Sand (water at 1920′)............	40	"	1940
Unrecorded to			2260
Pencil cave	5	"	2265
Unrecorded to			2315
Big Injun Sand (gas and water at 2320′)	175	"	2490
Unrecorded to......................			2510
Sand (Squaw)	40	"	2550
Unrecorded to (show of oil 2920 to 2990′, gas at 2960′)			3010
Fifty-foot Sand	20	"	3130
Red sand	10	"	3140
Unrecorded to			3160
Thirty-foot Sand	20	"	3180
Unrecorded to			3210
"Stray" Sand (Campbells Run)........	30	"	3240
Fourth Sand at			3256
Oil at			3275
Second pay			3280

Sanford Toothman Well, No. 1.

On Flat run, Marion county.

	Feet.		Feet.
Unrecorded to			130
Sand	15	to	145
Unrecorded to Mapletown Coal at			915
Unrecorded to Pittsburg Coal at			1000
Unrecorded to			1160
Sand (water)	15	"	1175
Unrecorded to Sand at			1440
Unrecorded to (cased 8¼″ at 1470′)			1490
Dunkard Sand	130	"	1620
"Gas" Sand at			1660
Unrecorded to			1870
Salt Sand (water at 1930′) (cased 6⅝″ at 1950′)	80	"	1950
Unrecorded to			2200
Pencil cave	6	"	2206
Unrecorded to			2250
Big Injun Sand (gas at 2270′) (show of oil at 2350′)	140	"	2390
Sand at (cased 5 3-16″ at 2445′)			2475
Unrecorded to			2900
Sand (Gantz) (show of oil at 2900)	15	"	2915
Unrecorded to			2930
Sand (Fifty-foot)	30	"	2960
Unrecorded to			2970
Sand	20	"	2990
Unrecorded to			3015
Sand	10	"	3025
Unrecorded to			3055
Sand	15	"	3070
Unrecorded to			3140
Sand (Campbells Run)	20	"	3160
Unrecorded to			3203
Fourth Sand (oil from 3203 to 3205′)	15	"	3218
Slate	6	"	3224
Fifth Sand	44	"	3268
Bottom of well			3268

W. R. Dickens Well, No. 1.

Flat run, Marion county.

	Feet.		Feet.
Unrecorded to			740
Pittsburg Coal	8	to	748
Unrecorded to (cased 10″ at 860′)			915
Sand	30	"	945
Unrecorded	295	"	1240
Dunkard Sand	100	"	1340
Unrecorded to			1775
Salt Sand	20	"	1795

Unrecorded to			1970
Pencil cave	10	"	1980
Big Lime	32	"	2012
Big Injun Sand (show of oil 2112′)	150	"	2162
Unrecorded to			2647
Gantz and Fifty-foot Sands	104	"	2751
Unrecorded to			2920
"Stray" Sand (Campbells Run)	21	"	2941
Unrecorded to			2960
Fourth Sand	26	"	2986
First pay at			2969
Second pay at			2973
Bottom of well			2992

Sarah Condit Well, No. 1.

Flat run, Marion county.

	Feet.		Feet.
Unrecorded to Mapletown Coal at (cased 10″ at 400)			1035
Unrecorded to Pittsburg Coal at			1131
Unrecorded to			1650
Dunkard Sand	45	to	1695
Unrecorded to			1825
"Gas" Sand	95	"	1902
Unrecorded to			2157
Salt Sand	113	"	2270
Unrecorded to			2360
Pencil cave	8	"	2368
Big Lime	52	"	2420
Big Injun Sand	135	"	2555
Sand	45	"	2600
Unrecorded to			3050
Gantz and Fifty-foot Sands	100	"	3150
Unrecorded to			3320
"Stray" Sand (Campbells Run)	25	"	3345
Fourth Sand at			3352
First pay			3354
Bottom of well			3358

Mike Snyder Well, No. 2.

Flat run, Marion county. Elevation above tide, 1,174 feet.

	Feet.		Feet.
Unrecorded to Pittsburg Coal at			810
Unrecorded to			1343
Dunkard Sand ($8\frac{1}{4}$″ casing, 1362′)	70	"	1413
Unrecorded to			1475
"Gas" Sand	65	"	1540
Unrecorded to			1810
Salt Sand	110	"	1920

Unrecorded to			2010
Pencil cave	6	"	2016
Big Lime (cased 6⅝″ at 2116′)	121	"	2137
Big Injun Sand (oil at 2211′) (cased, 5 3-16, 2261′)	133	"	2270
Unrecorded to			2710
Gantz Sand	45	"	2755
Unrecorded to			2770
Fifty-foot Sand	35	"	2805
Unrecorded to "Thirty-foot" Sand at...			2825
Unrecorded to			2970
"Stray" Sand (Campbells Run)	55	"	3025
Fourth Sand at (oil at 3044 and 3060′)..			3032 6″
Bottom of well			3064

Joseph Hayhurst Well, No. 1.

About two miles from Brink Postoffice, in Marion county.

	Feet.		Feet.
Unrecorded to			844
Pittsburg Coal	11	to	855
Unrecorded to			1327
Dunkard Sand (cased 8¼″ at 1352′)	38	"	1365
Unrecorded to Salt Sand at (gas at 1870′)			1750
Unrecorded to			1990
Sand (Maxton)	40	"	2030
(Oil, steel line, 2000; oil and water 2020′)			
Unrecorded to (cased 6⅝″, 2120).......			2143
Big Injun Sand (water)	107	"	2250
Unrecorded to			2760
Fifty-foot Sand (pebbly) (gas at 2790′)	45	"	2805
Sand and slate	188	"	2993
(Show of oil at 2823′; and 2981′, in pebbly sand)			
Gordon Sand (Campbells Run)..........	37	"	3030
(Gas show; increase, 3000′)			
(Show of oil, 3005′) (Gas at 3010′)			
Slate	58	"	3088

W. N. Cunningham Well.

On the head of Owen Davy run, one mile east from Brink Postoffice, Marion county.

	Feet.		Feet.
Unrecorded to			500
"Bluff" Sand	50	to	550
Unrecorded to			904
Pittsburg Coal	6	"	910
Unrecorded to (cased 8¼″ at 1247′).....			1400
Dunkard Sand	45	"	1445

Unrecorded to			1800
Salt Sand	145	"	1945
Unrecorded to (cased 6⅝″ at 1988′ 8″)			2170
Pencil slate	4	"	2174
Big Lime	37	"	2211
Big Injun Sand (no gas, water or oil)	125	"	2336
Unrecorded to			2820
Gantz Sand	40	"	2860
Slate	10	"	2870
Fifty-foot Sand	10	"	2880
Slate	35	"	2915
Red rock	15	"	2930
Sand (pebbly) (show of gas at 2935′) ("30-Foot")	15	"	2945
Slate and shells	65	"	3010
"Stray" Sand, hard and close	25	"	3035
(Small show of oil at 3015′)			
Slate, black	7	"	3042
Gordon Sand, pebbly (Campbells Run)	28	"	3070
(Gas at 3145; show of oil 3060′.)			
Slate, black	30	"	3100
Sand, black, soft	9	"	3109
Slate, black	30	"	3139
Bottom			3139

J. Mason Gas Well, No. 1.

Near Joetown, Marion county.

	Feet.
Mapletown Coal	128
Pittsburg Coal	228
Big Injun Sand	1600
(Cased 6⅝″ at 1622′.)	
Gantz Sand	2150
Fifty-foot Sand	2160
"Stray" Sand	2375
Gordon Sand (two streaks of gas)	2418
Slate	2434
Fourth Sand (increase of gas)	2437
Slate	2454
Sand shell (Fifth Sand)	2476
Black slate	2480
Bottom of well	2495

Daniel Mason Well, No. 1.

Near Joetown, Marion county.

	Feet.		Feet.
Unrecorded to			475
Pittsburg Coal	9	to	484
Unrecorded to			900

Little Dunkard Sand	30	"	930
Unrecorded to Dunkard Sand at			1020
Unrecorded to			1170
"Gas" Sand	60	"	1230
Unrecorded to			1293
Salt Sand	137	"	1430
Unrecorded to			1463
Sand	202	"	1665
Unrecorded to			1722
Big Lime	83	"	1805
Big Injun Sand	105	"	1910
Unrecorded to			2375
Gantz Sand	80	"	2455
Slate	15	"	2470
Fifty-foot Sand at (strong gas at 2475′)			2470
Unrecorded to "Thirty-foot" Sand at			2600
Stray Sand (Campbells Run)			2640
Fourth Sand			2675
Bottom			2759

A. Ashcraft Gas Well, No. 1.

Near Joetown, Marion county.

	Feet.		Feet.
Unrecorded to			280
"Bluff" Sand	40	"	320
Unrecorded to Mapletown Coal at			535
Unrecorded to Pittsburg Coal at			635
Unrecorded to			1055
Dunkard Sand	55	"	1110
Unrecorded to (8¼″ casing 1155′)			1320
Sand (gas)	80	"	1400
Unrecorded	20	"	1420
Sand (water)	20	"	1440
Unrecorded to			1570
Salt Sand	100	"	1670
Unrecorded to Pencil cave at			1880
Unrecorded to			1950
Big Injun Sand (6⅝″ casing at 1969′)	100	"	2050
Unrecorded to			2520
Gantz Sand	16	"	2536
Slate	5	"	2541
Sand	10	"	2551
Red rock	4	"	2555
Sand	35	"	2590
Slate	15	"	2605
Sand	35	"	2640
Red rock and slate	30	"	2670
Sand ("Thirty-foot")	20	"	2690
Slate	45	"	2735

Sand (Stray)	40	"	2775
Slate and shells	30	"	2805
Gordon Sand (Campbells Run)	20	"	2825
(Gas at 6 ft. in Gordon Sand.)			
Slate	20	"	2845
Fourth Sand	20	"	2865
Slate to bottom at			2889

WETZEL COUNTY WELL RECORDS.

Wetzel county lies directly west from Monongalia and Marion, and occupies the bottom of the great Appalachian trough. This geosyncline is itself traversed, however, by several low anticlinal folds which pass across Wetzel county, so that the conditions for oil and gas accumulation are ideal. Hence it has resulted that Wetzel has proven the banner county of the State so far as oil and gas production is concerned, nearly every portion of its 360 odd square miles of area being productive of either oil or gas in paying quantities. The productive sands of Wetzel county extend from the Dunkard, or First Cow Run, down to a sand 2,225 feet below the Pittsburg Coal, which is either the Fourth or Fifth of the Venango Group, but the most of the production has come from what the oil fraternity has called the *Gordon "Stray,"* and regular *Gordon Sand*, 10 to 15 feet lower, and approximately 2,100 feet below the Pittsburg Coal. The "Stray" is the great gas horizon of Wetzel, and has also produced much oil. The *Big Injun Sand* has also proven very prolific of oil and gas in eastern Wetzel, while recently the *Maxton Sand,* an oil horizon first developed on the Maxton farm, near Sistersville, in Tyler county, has proven quite productive of oil a short distance northeast from Burton. This sand was formerly believed to be the bottom member of the Pottsville, but the records from Wetzel county place it clearly in the *Mauch Chunk Red Shale Series,* which always has a sandy horizon near its center.

We shall now give a number of records from the several portions of Wetzel county, as follows:

Sol Shriver Well, No. 1.

Two miles east of Burton. Authority Carter Oil Company.

	Feet.		Feet.
Mapletown Coal	912	to	917

Pittsburg Coal	1012	"	1014
Cave	1014	"	1032
Little Dunkard Sand	1332	"	1376
Dunkard Sand	1410	"	1442
Sand	1460	"	1925
Little Lime	2145	"	2160
Big Lime	2195	"	2280
Big Injun Sand (water at 2505′)	2280	"	2535
Pencil cave	2840	"	2870
Gantz Sand	2870	"	2966
"Fifty-foot" Sand	2973	"	3003
"Thirty-foot" Sand (gas, 3029′; oil, 3044′)	3023	"	3055
"Stray" Sand	3070	"	3085
Gordon Sand	3105	"	3175
Fourth Sand	3185	"	3219
Bayard Sand	3377	"	3383
(Two-barrel well.)			

Jackson Hostutler Well, No. 1.

Two miles northeast of Burton. Authority, Fisher Oil Company.

	Feet.		Feet.
"Bluff" Sand	926	to	966
Waynesburg Coal	972	"	974
Mapletown Coal	1218	"	1222
Pittsburg Coal	1313	"	1319
Little Dunkard Sand	1725	"	1765
Big Dunkard Sand	1789	"	1867
Sand	1998	"	2082
"Gas" Sand	2105	"	2185
Salt Sand (little gas, 2298′)	2296	"	2316
Pencil cave	2504	"	2508
Big Lime	2508	"	2568
Big Injun Sand (gas, 2573′ and oil at 2588′)	2568	"	2808
Fifty-foot Sand	3274	"	3330
Sand	3334	"	3354
Red rock	3364	"	3370
Gordon "Stray"	3384	"	3402
Sand, Gordon	3438	"	3462
Sand	3472	"	3490
Sand (Fourth)	3516	"	3530
Sand (Fifth)	3570	"	3585
Lime	3810	"	3813
Hard lime	3828	"	3845
Slate to bottom	3845	"	3985

Winona Shough Well, No. 1.

One mile and a half northeast of Burton. Authority, South Penn Oil Company.

	Feet.		Feet.
Bluff Sand	515	to	545
Coal, Waynesburg	545	"	550
Sand	605	"	618
Mapletown Coal	787	"	792
Pittsburg Coal	890	"	898
Red rock	1155	"	1185
Slate and lime	1185	"	1260
Little Dunkard Sand	1260	"	1295
Big Dunkard Sand	1365	"	1395
"Gas" Sand	1660	"	1775
Salt Sand (little gas 1875′)	1790	"	1896
Maxton Sand (oil show 2030′)	1984	"	2059
Pencil cave	2059	"	2069
Big Lime	2069	"	2134
Big Injun Sand	2134	"	2382
Sand	2482	"	2582
"Fifty-foot" Sand	2800	"	2850
"Thirty-foot" Sand	2894	"	2926
Gordon "Stray?"	2934	"	2957
Little gas and oil show, 2944′.			
Sand, very hard	2982	"	3032
Sand, good	3040	"	3070
Sand, hard (Fourth?)	3072	"	3090
Sand (Fifth?)	3106	"	3124
Slate and shells	3124	"	3189
Depth			3189

Record of the John Santee Well, No. 5.

One mile northeast of Burton. Authority, Mr. J. P. Hagan, of the Syndicate Oil and Gas Company.

	Feet.		Feet.
Wood conductor			15
Pittsburg Coal			1085
Little Dunkard Sand	1475	"	1520
Big Dunkard Sand	1835	"	1900
"Gas" Sand (little salt water)	1835	"	2100 (?)
Salt Sand	2025	"	2100
Red rock	2120	"	2183
Maxton Sand	2183	"	2263
First show of oil	2118		
More oil at	2225		
Best "pay" at	2242		
Total depth of well	2263		

Ten-inch casing, 285′; 8¼″ casing, 1475′; 6⅝″ casing, 2183′. Sand hard, shot with 100 quarts of nitroglycerine.

Leezer Well, No. 1.

Near Burton. Authority, Fisher Oil Company.

	Feet.		Feet.
Maxton Sand	2307	to	2395
Top first pay	2339		
Bottom first pay	2347		
Pencil cave	2395	"	2397
Big Lime	2397	"	2463
Big Injun	2363		
Total depth	2591		

Bartrug Well, No. 1.

One mile northeast of Burton. Authority, Fisher Oil Company.

	Feet.		Feet.
Pittsburg Coal	1262		
First Salt Sand	2065	to	2141
Second Salt Sand	2201	"	2255
Red cave	2343	"	2385
Maxton Sand (light gas)	2385	"	2436
First pay	2418	"	2420
Total depth			2436

John Maple Well, No. 4.

One mile northeast of Burton. Authority, Fisher Oil Company.

	Feet.		Feet.
Pittsburg Coal	1190		
Little Dunkard Sand	1575	to	1625
Big Dunkard Sand	1655	"	1690
Salt Sand	2120	"	2190
Red cave	2256	"	2318
Maxton Sand	2318		
First pay	2350	"	2352
Second pay	2365	"	2370
Total depth			2373

W. G. Snodgrass Well, No. 1.

One mile northeast of Burton. Authority, Fisher Oil Company.

	Feet.		Feet.
Pittsburg Coal	1179		
Little Dunkard Sand	1558	to	1620
Big Dunkard Sand	1640	"	1680
Salt Sand	2112	"	2165
Red cave	2225	"	2311
Maxton Sand	2311	"	2363
First pay	2335	"	2342
Second pay	2353	"	2358
Total depth			2363

The records of these five preceding wells show conclusively that the Maxton Sand belongs in the *Mauch Chunk Series,* its top coming 83 feet below the base of the Pottsville, and its base just above the "Pencil cave," or 68 feet above the *Big Injun Oil Sand,* so that the position of the *Maxton Sand* is practically midway between the Pottsville and Pocono beds, its base coming close down to the top of the Mountain or Greenbrier ("Big Lime" of the drillers) Limestone.

Joseph Province Well, No. 1.

One mile northwest of Sincerity Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	1035	to	1050 (?)
Cave	1460	"	1530
Cow Run Sand	1510	"	1550
Salt Sand (water, 1915′)	1780	"	1960
Maxton Sand	2035	"	2075
Pencil cave	2190	"	2200
Limestone	2200	"	2280
Big Injun Sand (gas, 2381′)	2309	"	2589
Pencil cave	3060	"	3070
Gordon Stray	3070	"	3100
Gordon Sand, poor	3100	"	3105
Total depth	3211		

Good gas well in "Stray" Sand.

S. L. Jolliff Well, No. 1.

About one mile southwest of Sincerity. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	8	to	777
Cow Run Sand (Dunkard)	30	"	1160
Salt Sand	350	"	1890
Cave (Pencil)	7	"	1967
"Big" Lime	63	"	2030
Big Injun Sand	185	"	2215
Unrecorded	375	"	2590
Berea Grit (Gantz?)	20	"	2610
Unrecorded	190	"	2800
Stray Sand	35	"	2835
Unrecorded	30	"	2865
Gordon Sand	23	"	2888
Total depth			3064

J. K. Morgan Well, No. 1.

One mile and a half southeast of Sincerity. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Pittsburg Coal	1170		
Little Dunkard Sand	1570		
Big Dunkard Sand	1675	to	1720
"Gas" Sand	1875	"	1920
Salt Sand	1960	"	2120
Little Lime	2340	"	2385
Pencil cave	2385	"	2395
Big Lime	2395	"	2480
Big Injun Sand	2485	"	2715
"Stray" Sand	3220	"	3235
Gordon Sand	3240	"	3262
Fourth Sand	3320	"	3336
Total depth	3496		
(Dry hole.)			

David Bellard Well, No. 1.

About one mile and a half north of Sincerity. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Mapletown Coal	846		
Pittsburg Coal	946	to	950
Little Dunkard Sand	1325	"	1355
Big Dunkard Sand	1430	"	1490
"Gas" Sand	1580	"	1640
Salt Sand	1800	"	1945
Little Lime	2100	"	2118
Pencil cave	2118	"	2145
Big Lime	2145	"	2210
Big Injun Sand (gas, 2260′)	2210	"	2460
"Stray" Sand	2992	"	2997
Gordon Sand (gas, 3041′)	3029	"	3065
Fourth Sand (oil, 3121′)	3115	"	3160
Fifth Sand	3200	"	3205
Total depth	3386		

James O'Day Well, No. 1.

Just south of Littleton and B. & O. R. R. Clay district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Pittsburg Coal	785	to	791
Dunkard Sand	1273	"	1333
Pencil cave	1960	"	1970
Big Injun Sand	2061	"	2280
"Thirty-foot" (Berea?)	2590	"	2630

"Fifty-foot" Sand	2737	"	2760
Gordon Sand	2887	"	2903
Fourth Sand (gas from 2958 to 2963′)	2958	"	2963
Total depth	2972		

Geo. Gillingham Well, No. 1.

One mile south of Littleton, Clay district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Mapletown Coal	1090		
Pittsburg Coal	1190		
Little Dunkard Sand	1575	to	1595
Big Dunkard Sand	1685	"	1735
"Gas" Sand	2000	"	2080
Salt Sand	2140	"	2270
Little Lime	2390		
Big Lime	2393	"	2468
Big Injun Sand	2480	"	2710
"Fifty-foot' Sand	3050		
Gordon Sand	3286	"	3332
Fourth Sand (oil, 3367′)	3362		
Total depth	3377		

Wm. McReynolds Well, No. 3.

One mile and a half south of Littleton, Clay district. Authority, South Penn Oil Company.

	Feet.		Feet.
Mapletown Coal	990		
Pittsburg Coal	1090	to	1100
Little Dunkard Sand	1490	"	1510
Big Dunkard Sand	1581	"	1627
Salt Sand	2040	"	2138
Maxton Sand	2250	"	2270
Little Lime	2296	"	2311
Big Lime	2316	"	2380
Big Injun Sand	2380	"	2600
"Fifty-foot" Sand	2910	"	2930
"Thirty-foot" Sand	3127	"	3136
Gordon Sand	3180	"	3226
Fourth Sand (oil, 3263′)	3260		
Total depth	3263		

S. Newman Well, No. 3.

One mile and a half southwest of Littleton, Clay district. Authority, South Penn Oil Company.

	Feet.		Feet.
Mapletown Coal	794		
Pittsburg Coal	894		
Little Dunkard Sand	1261	to	1281

Dunkard Sand	1371	"	1425
"Gas" Sand	1635	"	1645
Salt Sand	1672	"	1770
Maxton Sand	1878	"	1925
Little Lime	2060		
Big Lime	2082	"	2165
Big Injun Sand	2165	"	2390
Gordon Sand (oil, 3017′)	3007	"	3030
Fourth Sand (oil, 3072′)	3068		
Total depth	3083½		

Wm. Newman Well, No. 3.

Two miles southwest of Littleton, Clay District. Authority South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Mapletown Coal	832		
Pittsburg Coal	932		
Little Dunkard Sand	1260	to	1285
Big Dunkard Sand	1400	"	1470
Gas Sand	1625	"	1650
Maxton Sand	2005	"	2050
Little Lime	2075	"	2130
Big Lime	2145	"	2206
Big Injun Sand (gas, 2296′)	2206	"	2440
"Stray" Sand	3015	"	3026
Gordon Sand	3031	"	3065
Fourth Sand (oil, 3105′)	3102		
Total depth	3118		
(Ten-barrel well.)			

L. J. Richmond Well, No. 1.

Near Brink, Grant district. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	1175		
Dunkard Sand	1675	to	1755
"Gas" Sand	1875	"	1955
Salt Sand (water at 2080′)	2058	"	2178
Big Lime	2400	"	2470
Big Injun Sand (gas, 2470′; oil, 2556′)	2470	"	2562
Slate	2564		
Bottom of well	2611		

Geo. W. Dye Well, No. 1.

Grant district. Authority, Carnegie Natural Gas Company.

	Feet.		Feet.
Unrecorded	1097	to	1097
Pittsburg Coal	5	"	1102
Unrecorded	1253	"	2355

Big Injun Sand	145	"	2500
Unrecorded	400	"	2900
"Fifty-foot" Sand	40	"	2940
Unrecorded	165	"	3115
Gordon "Stray" (gas at 3128′)	46	"	3161
Gordon Sand (gas at 3162′ and 3179′)	20	"	3181
Total depth			3195

S. R. Cain—Federal Oil Co. Well, No. 2.

One mile and a half east of Robinson's mill. Authority, Benedum Brothers.

	Feet.		Feet.
Pittsburg Coal	960	to	965
Little Dunkard Sand	1365	"	1395
Big Dunkard Sand	1490	"	1510
Salt Sand (water, 1820′)	1780	"	1840
Pencil cave	2175	"	2178
Big Lime	2178		
Big Injun Sand	2258	"	2286
"Fifty-foot" Sand	2870	"	2880
"Stray"	2995	"	3043
Show of oil	3047		
Slate	3060	"	3074
Gordon Sand (gas, 3080′)	3074	"	3105
Total depth	3105		
(Small oil well.)			

Z. M. Price Well, No. 2.

Two miles northwest of Folsom, Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1084	to	1091
Dunkard Sand	1590	"	1630
Salt Sand	1875	"	2095
Little Lime	2265	"	2275
Pencil cave	2275	"	2295
Big Lime	2295	"	2380
Big Injun Sand	2380	"	2515
"Fifty-foot" Sand	2910	"	2945
Red rock	2960	"	2995
Gordon "Stray" (oil, 3175′)	3139	"	3178
Gordon Sand	3182	"	3207
Total depth	3209		
(Fifty-seven-barrel well.)			

Jesse Ashcraft Well, No. 1.

West end of Short Line Railroad Tunnel, east of Folsom, Grant district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	942	to	949
Dunkard Sand	1432	"	1480
"Gas" Sand	1630	"	1700
Salt Sand	1900	"	2050
Pencil cave	2135	"	2140
Big Lime	2140	"	2200
Big Injun Sand	2200	"	2325
"Fifty-foot" Sand	2800	"	2825
"Bowlder" Sand (Thirty-foot)	2900	"	2925
"Stray" Sand (gas, 2993′)	2958	"	3010
Gordon Sand (oil, 3028 to 3039′)	3028	"	3048
Slate to bottom	3048	"	3053

Taylor Talkington Well, No. 2.

One mile southeast of Folsom, Grant district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1191	"	1197
Dunkard Sand	1680	"	1700
Salt Sand	2066	"	2128
Pencil cave	2368	"	2372
Big Lime	2372	"	2460
Big Injun Sand	2460	"	2563
"Fifty-foot" Sand	3056	"	3090
"Thirty-foot" Sand	3120	"	3140
"Stray"	3200	"	3255
Gordon Sand (oil, 3267′)	3255	"	3274
Slate	3274	"	3292
Total depth	3292		
(Thirty-barrel well.)			

W. B. Starkey Well, No. 3.

Two miles northeast of Folsom, Grant district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1059		
"Gas" Sand	1765	to	1795
Salt Sand	1890	"	2025
Little Lime	2260	"	2270
Pencil cave	2270	"	2283
Big Lime	2283	"	2330
Big Injun Sand (gas and water)	2330	"	2350
"Fifty-foot" Sand	2950	"	2970
"Boulder" Sand	3060	"	3030
Stray Sand	3100	"	3150
First pay	3132		
Second pay	3137		

Gordon Sand	3159	"	3197
Total depth	3200		
(Twenty-two-barrel well.)			

Genine Robinson Well, No. 40.

Two miles northeast of Folsom, Grant District. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1320	to	1325
Big Dunkard Sand	1820	"	1920
Salt Sand	2220	"	2320
Big Lime	2550	"	2630
Big Injun Sand	2630	"	2730
"Fifty-foot" Sand	3220	"	3245
Gordon "Stray" (oil, 3400′)	3350	"	3414
Slate	3414	"	3424
Gordon Sand	3424	"	3449
Slate	3449	"	2451
Total depth	3451		

Michael Mannion Well, No. 2.

About two miles south of Folsom, Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1175	to	1180
Dunkard Sand	1600	"	1630
Salt Sand	2070	"	2180
Pencil cave	2350	"	2360
Big Lime	2360	"	2450
Big Injun Sand	2450	"	2525
"Thirty-foot" (Berea?)	2775	"	2980
"Fifty-foot" Sand	3030	"	3040
Lower "Thirty-foot" Sand	3115	"	3150
"Stray" (gas, 3200′)	3180	"	3246
Slate	3246	"	3258
Gordon Sand (oil, 3258′)	3258	"	3278
Total depth	3297		

H. L. Smith Well, No. 54.

One mile northeast of Smithfield, Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	965	to	972
Little Dunkard Sand	1390	"	1400
Big Dunkard Sand	1485	"	1503
"Gas" Sand	1600	"	1660
Salt Sand	1760	"	1985
Pencil cave	2180	"	2190

Big Lime	2190	"	2260
Big Injun Sand	2260	"	2485
"Fifty-foot" Sand	2961	"	3012
"Stray" Sand	3047	"	3062
Gordon Sand	3072	"	3089
First pay	3074		
Total depth	3092		

Blackshere, Wells & Co.'s Well, No. 1. 1892.

Smithfield region. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Washington)	195	to	200
Pittsburg Coal	715	"	725
Dunkard Sand	1200	"	1280
Salt Sand	1670	"	1715
Slate	1715	"	1778
Black slate	1778	"	1838
Red rock	1838	"	1878
Slate and shells	1878	"	1978
Big Lime	1978	"	2048
Big Injun Sand, hard	2048	"	2058
Sand, soft (gas, 2058′)	2058	"	2070
Slate and lime, breaks	2070	"	2073
Sand. hard and white	2073	"	2102
Sand, soft (gas, 2102′; oil, 2122′)	2102	"	2122
Sand, hard (water, 2133′)	2122	"	2152
Slate to bottom	2152	"	2153

Margaret Gump Well, No. 1.

Smithfield region. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	760	to	765
"Dunkard" Sand (Saltzburg)	1094	"	1109
Oil, 1109′.			
Total depth			1120

The drillers have called this Sand the "Dunkard," although its top is only 334 feet below the Pittsburg Coal, while the "Little" Dunkard Sand (Upper Mahoning) of that region lies 100 feet lower, or 400 to 430 feet below the Pittsburg Coal, and the "Big" Dunkard Sand (Lower Mahoning) comes 500 feet below the Pittsburg Coal, as may be seen by the several previous records. Hence, this oil sand on the Margaret Gump farm is not one of the Dunkard Sands at all, since they are the Upper (Buffalo) and Lower Mahoning beds, the principal oil horizon being in the Upper one at 440 feet below the Pitts-

burg Coal. The sand in question comes at the horizon of the Saltzburg sandstone and is identical with that which holds the very light gravity (63½°) oil near Moundsville, Marshall county, at 300 feet below the Pittsburg Coal, and, hence, is improperly called Dunkard, although it may be identical with the First "Cow Run" Sand in Ohio, and many other places in West Virginia.

In the record of the Margaret Gump well, No. 2, which follows, the driller has given the name "Dunkard" Sand to a stratum whose top lies 540 feet below the Pittsburg Coal, while in the J. S. Stout well, No. 2, the next record given, he has applied the term "Dunkard" to a sand struck at only 500 feet below the Pittsburg Coal, so that in reading the drillers' records, one must always refer his names to some definite horizon, like the Pittsburg Coal or Big Injun Sand, which he seldom mistakes, in order to know what stratum is represented by the term used.

Margaret Gump Well, No. 2.

Smithfield region. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	970	to	980
Dunkard Sand	1520	"	1600
Salt Sand	1900	"	1970
Little Lime	2170	"	2190
Pencil cave	2190	"	2195
Big Lime	2195	"	2266
Big Injun Sand	2266	"	2393
Red Sand	3020	"	3040
"Stray" Sand	3064	"	3080
Gordon Sand (oil, 3092′ and 3097′)	3085	"	3097
Total depth	3106		

J. S. Stout Well, No. 2.

Smithfield region. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	825	to	831
Dunkard Sand	1325	"	1350
Salt Sand	1700	"	1809
Red rock	1945	"	2005
Pencil cave	2030	"	2036
Big Lime	2036	"	2143
Big Injun Sand (oil, 2223′)	2143	"	2263
"Fifty-foot" Sand	2825	"	2855
"Thirty-foot" Sand	2880	"	2900

Stray Sand (gas, heavy, 2918′)	2915	"	2
Gordon Sand (oil, 2964 to 2965′)	2953		
Total depth	2973		

Wm. Gallagher Well, No. 1.

Near Mobley Postoffice. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	610	to	618
Big Dunkard Sand	1080	"	1110
"Gas" Sand	1244	"	1320
Salt Sand	1430	"	1650
Pencil cave	1805	"	1812
Big Lime	1812	"	1884
Big Injun Sand (gas, 1900′)	1884		
Total depth	2002		
(Steel line.)			

L. E. Dulaney Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	870	to	876
Dunkard Sand	1360	"	1385
Salt Sand	1725	"	1875
Little Lime	2020	"	2035
Pencil cave	2035	"	2040
Big Lime	2040	"	2095
Injun Sand	2095	"	2245
Red rock	2760	"	2830
Gordon "Stray"	2885	"	2910
Gordon Sand (oil, 2920½′)	2917		
Total depth	2939½		

J. Chamberlain Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	685	"	693
Dunkard Sand	1200	"	1250
Salt Sand	1535	"	1635
Little Lime	1830	"	1860
Pencil cave	1860	"	1870
Big Lime	1870	"	1930
Big Injun Sand	1930	"	2173
"Fifty-foot" Sand	2500	"	2550
Red rock	2620	"	2650
Gordon Sand (oil, 2751′)	2748		

Wiley Fluharty Well, No. 2.

Authority, South Penn Oil Company .

	Feet.	Feet.
Pittsburg Coal	790	

Big Injun Sand	2100	to	2270
"Stray" Sand (gas 2850-5′)	2832	"	2850
Gordon Sand (oil, 2863′)	2854	"	2874
Total depth	2900		

Presley Martin Well, No. 5.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	788	to	796
Dunkard Sand	1300	"	1330
"Gas" Sand	1470	"	1540
Salt Sand	1590	"	1770
Little Lime	1970	"	1983
Pencil cave	1983	"	1988
Big Lime	1988	"	2038
Big Injun Sand	2038	"	2278
"Stray" Sand	2829	"	2859
Gordon Sand (oil, 2861′)	2859	"	2877

M. Gorby Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	622	to	628
Dunkard Sand	1150	"	1200
Pencil cave	1840	"	1845
Big Lime	1845	"	1900
Big Injun Sand	1900	"	2125
Red rock	2535	"	2580
Gordon "Stray"	2675		
Gordon Sand (oil 2720′)	2720	"	2731

M. Gorby Well, No. 2.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	550	to	560
Dunkard Sand	1075	"	1135
Salt Sand	1350	"	1410
Pencil cave	1770	"	1780
Big Lime	1780	"	1820
Big Injun Sand (water, 1940′)	1820	"	2060
"Fifty-foot" Sand	2400		
Red rock	2470		
Gordon "Stray"	2605		
Gordon Sand (oil, 2645′)	2615	"	2650
Total depth	2801		

Laura Hearne Well, No. 9.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	695	to	701

Dunkard Sand	1225	"	1275
Salt Sand	1500	"	1650
Little Lime	1900	"	1930
Pencil cave	1930	"	1940
Big Lime	1940	"	2000
Big Injun Sand	2000	"	2130
"Fifty-foot" Sand	2525	"	2575
Red rock	2630	"	2650
Gordon "Stray"	2740		
Gordon Sand	2785		

John Ingram Well, No. 3.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1080	to	1088
Dunkard Sand	1575	"	1625
Salt Sand	1830	"	2140
Little Lime	2240	"	2275
Pencil cave	2275	"	2282
Big Lime	2282	"	2345
Big Injun Sand	2345	"	2585
Red rock	3005	"	3050
Gordon "Stray"	3110		
Gordon Sand	3140		
Total depth			3159

A. Long Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	600	to	608
Dunkard Sand	1125	"	1185
Salt Sand	1400	"	1550
Little Lime	1775	"	1805
Pencil cave	1805	"	1815
Big Lime	1815	"	1875
Big Injun Sand	1875	"	2025
"Fifty-foot" Sand	2415	"	2465
Red rock	2540	"	2575
Gordon "Stray"	2628		
Gordon Sand (oil, 2664½′)	2663	"	2682

H. L. Smith Well, No. 29.

Eastern Wetzel. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	750	to	758
Dunkard Sand	1400	"	1480
"Gas" Sand	1550	"	1620
Salt Sand	1680	"	1750
Big Lime	1990	"	2050
Big Injun Sand (oil, 2137′)			2050

H. L. Smith Well, No. 41.

Eastern Wetzel. Authority, South Penn Oil Company.

Pittsburg Coal	1100	to	1105
Dunkard Sand	1630	"	1660
Salt Sand	2020	"	2100
Pencil cave	2305	"	2310
Big Lime	2310	"	2392
Big Injun Sand (gas, 2409′)	2392		
Oil show at	3153½		
Gas in "Stray" Sand at	3180½		
Gordon Sand	3203½	"	3219½
Total depth	3273½		

David Norris Well, No. 6.

Eastern Wetzel. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1005	to	1013
Dunkard Sand	1512	"	1517
Salt Sand	1910	"	2015
Pencil cave	2235	"	2240
Big Lime	2240	"	2300
Big Injun Sand (oil, 2387′)	2300		
Total depth			2399

J. B. Dewhurst Well, No. 6.

Injun Sand development, Eastern Wetzel. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Washington)	228	to	231
Pittsburg Coal	745	"	753
Dunkard Sand	1195	"	1213
"Gas" Sand	1590	"	1688
Salt Sand	1728	"	1815
Black Lime	2015	"	2055
White Lime	2055	"	2082
Black sand (Keener Sand)	2082	"	2100
Big Injun Sand (oil, 2174′)	2100		

F. S. Snodgrass Well, No. 7.

Grant district. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	1261		
"Gas" Sand	2073	to	2108
Salt Sand	2148	"	2250
Pencil cave	2477		
Big Lime	2483	"	2566
Big Injun Sand	2566	"	2642½

Franklin Blake Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1312	to	1320
Dunkard Sand	1770	"	1850
"Gas" Sand	1920	"	2014
Salt Sand	2054	"	2300
Pencil cave	2478	"	2485
Big Lime	2485	"	2550
Big Injun Sand	2550	"	2770
Sand	2890	"	2920
"Fifty-foot" Sand	3120	"	3135
Gordon "Stray"	3325	"	3366
"Break" (slate)	3366	"	3378
Gordon Sand (oil, 3378′)	3378	"	3384
Total depth	3392		

A. D. Kimble Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	875	to	883
Dunkard Sand	1375	"	1410
Salt Sand	1730	"	1950
Little Lime	2100	"	2115
Pencil cave	2115	"	2121
Big Lime	2121	"	2180
Big Injun Sand	2180	"	2400
Red rock	2800	"	2850
Gordon "Stray"	2909		
Gordon Sand (oil, 2947′)	2944	"	2962

John Palmer Well, No. 7.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1106	to	1114
Dunkard Sand	1610	"	1665
Salt Sand	1875	"	2100
Little Lime	2250	"	2260
Pencil cave	2260	"	2270
Big Lime	2270	"	2335
Big Injun Sand	2335	"	2455
"Fifty-foot" Sand	2870	"	2915
Red rock	3005	"	3050
"Stray" Sand	3139	"	3166
Gordon Sand(oil, 3170′)	3167	"	3185

M. A. Miller Well, No. 8.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	910	"	918
Dunkard Sand	1400	"	1430
Salt Sand	1660	"	1970
Little Lime	2074	"	2104
Pencil cave	2104	"	2110
Big Lime	2110	"	2160
Big Injun Sand	2160	"	2390
Red rock	2816	"	2866
"Stray" Sand	2946		
Gordon Sand (oil, 2979′)	2976	"	2996

Bishop Penick Well, No. 3.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1124	to	1132
Dunkard Sand	1625	"	1655
Salt Sand (water, 1910′)	1904	"	2175
Little Lime	2305	"	2314
Pencil cave	2314	"	2319
Big Lime	2319	"	2614
"Fifty-foot" Sand	2950	"	2995
Red rock	3030	"	3065
"Stray" Sand	3160		
Gordon Sand (oil, 3195′)	3192	"	3209

A. B. Straight Well, No. 2.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	800	to	807
Dunkard Sand	1260	"	1305
Salt Sand	1610	"	1700
Little Lime	1896	"	1910
Pencil cave	1910	"	1925
Big Lime	1925	"	1965
Big Injun Sand	1965	"	2215
"Fifty-foot" Sand	2605	"	2670
Red rock	2700	"	2750
"Stray" Sand	2837	"	2855
Gordon Sand (oil, 2888′)	2869	"	2914

Zue Lantz Well, No. 2.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	501	to	507
Dunkard Sand	990	"	1050
Salt Sand	1410	"	1465

Maxton Sand	1590	"	1635
Little Lime	1650	"	1665
Pencil cave	1665	"	1675
Big Lime	1675	"	1730
Big Injun Sand	1730	"	1985
"Fifty-foot" Sand	2310	"	2335
Red rock	2395	"	2450
Gordon "Stray"	2544		
Gordon Sand (oil, 2578')	2574½	"	2626

Helen M. Jamison Well, No. 9.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1170		
Big Injun Sand	2505	to	2680
"Stray" Sand	3238	"	3265
Gordon Sand (oil, 3272')	3268	"	3301
Total depth	3317		

J. U. Jolliffe Well No. 2.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	770	to	778
Dunkard Sand	1285	"	1335
Salt Sand (salt water, 1675')	1620	"	1750
Little Lime	1920	"	1950
Pencil cave	1950	"	1960
Big Lime	1960	"	2010
Big Injun Sand	2010	"	2250
"Fifty-foot" Sand	2610	"	2650
Red rock	2690	"	2740
Gordon "Stray"	2817		
Gordon Sand (oil, 2860')	2847	"	2860

James Jolliffe Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	600	to	608
Dunkard Sand	1075	"	1110
Salt Sand	1500	"	1610
Little Lime	1725	"	1735
Pencil cave	1735	"	1740
Big Lime	1740	"	1775
Big Injun Sand	1775	"	2000
Red rock	2520		
Gordon "Stray"	2647		
Gordon Sand (oil, 2685')	2682	"	2703½
Oil	2685		
Bottom	2703½		

Annie Muffney Well, No. 1.

Grant district. Authority, Carter Oil Company, A. T. 940 feet.

	Feet.		Feet.
Waynesburg Coal	325		
Mapletown Coal	565		
Pittsburg Coal	675		
Red rock	25	to	825
Sand	15		
Red rock	50		
First Cow Run Sand	30	"	1130
Dunkard Sand	45		
Sand	225		
Break (slate)	5		
Sand	45	"	1500
Shell	50		
Salt Sand (water 1600 and 1620′)	170		
Red rock	20		
Maxton Sand	20		
Black slate	35		
Red rock	50		
Limestone	15		
Pencil cave	10		
Big Lime	70		
Big Injun	176	"	2146

Little gas at 1985, more at 2016′.

J. D. Morgan Well, No. 11.

Eastern Wetzel. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	650	to	660
Dunkard Sand	1150	"	1190
"Gas" Sand	1400	"	1448
Salt Sand	1570	"	1660
Pencil cave	1870	"	1880
Big Lime	1880	"	1945
Big Injun Sand (oil, 2031′)	1945	"	2043

J. D. Morgan Well, No. 30.

Eastern Wetzel. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	725	to	731
Dunkard Sand	1240	"	1290
"Gas" Sand	1290	"	1490
Salt Sand	1625	"	1725
Little Lime	1910	"	1922
Pencil cave	1922	"	1937
Big Lime	1937	"	1997
Black sand (Keener)	1997	"	2010

Big Injun Sand (oil, 2105′)	2010		
"Fifty-foot Sand	2628	"	2675
"Thirty-foot" Sand	2746	"	2778
Slate and shells	2778	"	2803
"Stray" Sand	2803	"	2828
Pencil cave	2828	"	2832
Gordon Sand (oil, 2837′)	2832	"	2847

D. H. Cox Well, No. 4.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	655	to	661
Dunkard Sand	1200	"	1250
Salt Sand	1500	"	1650
Maxton Sand	1775	"	1850
Little Lime	1850	"	1860
Pencil cave	1860	"	1870
Big Lime	1820	"	1920
Big Injun Sand	1920	"	2160
"Fifty-foot" Sand	2480	"	2520
Red rock	2580	"	2620
Gordon "Stray"	2708		
Gordon Sand	2724	"	2759

John Willey Wells, Nos. 1, 2 and 3.

Three miles northeast from Jacksonburg. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	Small	to	640
Cow Run Sand (Saltzburg)	10	"	960
Salt Sand	400	"	1200
Maxton Sand	58	"	1770
Oil in Big Injun Sand at			1813
Total depth			1838

John Willey Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	5	"	775
Cow Run (Dunkard)	30	"	1280
Salt Sand	30	"	1500
Maxton Sand	60	"	1955
Big Lime	65	"	2000
Big Injun Sand	240	"	2065
"Stray" Sand	23	"	2831
Gordon Sand	21	"	2854
Total depth			2879

John Willey Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	8	to	785

Salt Sand	160	"	1640
Maxton Sand	65	"	1945
Big Lime	55	"	2020
Big Injun Sand	235	"	2075
"Stray" Sand	15	"	2855
Gordon Sand	23	"	2870
Total depth			2901

F. W. Bartlett Wells, Nos. 1, 2 and 3.

Adjoining John Willey, northeast of Willey farm.

	Feet.		Feet.
Pittsburg Coal			818
Cow Run Sand			1170
Salt Sand			1739
Big Lime			2055
Big Injun Sand	240	to	2100
"Stray" Sand	20	"	2885
Gordon Sand	25	"	2905

F. W. Bartlett Well, No. 2.

	Feet.		Feet.
Pittsburg Coal			1000
Dunkard Sand			1542
Salt Sand			1914
Big Injun	222	to	2288
"Stray" Sand			2840
Gordon Sand			3067

F. W. Bartlett Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	7	to	908
Cave	60	"	1360
Dunkard Sand	40	"	1420
Salt Sand	300	"	1600
Maxton	40	"	2060
Limestone	50	"	2130
Big Injun Sand	200	"	2180
Gantz Sand	30	"	2804
"Stray" Sand	30	"	2958
Gordon Sand			2988

M. V. Anderson Wells, Nos. 1, 2 and 3.

One mile southeast of Jacksonburg. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	7	to	625
Dunkard Sand	25	"	1000
Salt Sand	400	"	1100
Big Lime	68	"	1830
Big Injun Sand	202	"	1894

Gordon Sand			2697

Oil and gas at 2727′ in Gordon Sand.

M. V. Anderson Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	8	to	520
Salt Sand	326	"	1114
Big Lime	60	"	1750
Big Injun Sand	200	"	1810
Gordon "Stray"	12	"	2582
Gordon Sand	40	"	2594
Total depth			2636

M. V. Anderson Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	6	to	1010
Dunkard Sand	40	"	1520
Salt Sand	300	"	1970
Big Lime	60	"	2219
Big Injun Sand	40	"	2297

G. W. Anderson Well, No. 4.

Jacksonburg, Wetzel county. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	8	to	474
Dunkard Sand	60	"	994
Salt Sand	300	"	1200
Maxton Sand	60	"	1220
Big Lime	47	"	1700
Big Injun Sand	250	"	1747
Berea Sand	30	"	2110
"Stray" Sand	15	"	2507
Gordon Sand	35	"	2527
Total depth			2590

J. M. Anderson Well, No. 1.

One mile southeast of Jacksonburg. Authority, United States Oil Company.

	Feet.		Feet.
Pittsburg Coal	580	to	585
Dunkard Sand	1125	"	1175
Salt Sand	1380	"	1430
Little Lime	1785	"	1805
Pencil cave	1805	"	1825
Big Lime	1825	"	1870
Big Injun Sand (gas, 1980′)	1870	"	2085
Red rock	2510	"	2550
Gordon (oil, 2675′)	2652	"	2680

J. M. Anderson Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	572	to	576
Dunkard	1100	"	1150
Salt Sand	1400	"	1450
Little Lime	1780	"	1810
Pencil cave	1810	"	1820
Big Lime	1820	"	1880
Big Injun Sand	1880	"	2110
"Fifty-foot" Sand	2415	"	2416
Red rock	2525	"	2550
Gordon Sand	2640	"	2674

Headlee Well, No. 1.

Near Jacksonburg. Authority, Kanawha Oil Company.

	Feet,
Pittsburg Coal	469
Big Injun Sand (gas, 1765′)	1750
"Stray" Sand	2520
Gordon Sand (gas, 2545′)	2545
Total depth	2571

Morgan Heirs' Well, No. 1.

Near Jacksonburg. Authority, Kanawha Oil Company.

	Feet.
Pittsburg Coal	495
Big Injun Sand	1825
"Stray" Sand	2565
Gordon Sand (100-barrel well)	2605

H. K. Cosgray Well, No. 1.

About two miles east of Uniontown. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	7	to	944
Dunkard Sand	38	"	1408
Salt Sand	123	"	1855
Big Lime	44	"	2142
Big Injun Sand	211	"	2186
"Stray" Sand	17	"	3034
Gordon Sand	21	"	3085
Total depth			3293

E. M. Ramsey Well, No. 1.

Center district, near Silver Hill. Authority, South Penn Oil Company.

	Feet.		Feet.
"Bluff" Sand (Marietta)	716	to	736
Mapletown (Sewickley) Coal	1165	"	1170

Pittsburg Coal	1259	"	1266
"Hurry Up" Sand (Connellsville)	1334	"	1374
Red rock	1380	"	1430
Little Dunkard Sand (Saltzburg)	1585	"	1620
Big Dunkard Sand	1775	"	1835
Upper Freeport Coal	1841	"	1846
"Gas Sand"	2038	"	2088
Salt Sand	2188	"	2288
Maxton Sand	2302	"	2377
Pencil cave	2418	"	2420
Big Lime	2425	"	2470
Big Injun Sand	2470	"	2710

This is a very important record in a geologic sense, since it shows the presence of the *Upper Freeport Coal* at 575 feet below the Pittsburg bed, and thus gives an accurate measurement of the Conemaugh formation, far from any region of its outcrop. The driller has here confused one of the Marietta beds above the Washington Coal with the "Bluff" Sand, which name is usually applied to the Waynesburg Sandstone, 100 feet below the Washington Coal.

F. F. Morgan Well, No. 1.

Willey Fork of Fishing creek, half-way between Sincerity and Cobun Postoffices. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	610	to	615
Cave	1000	"	1060
Dunkard Sand	1080	"	1120
Salt Sand (gas)	1400	"	1700
Pencil cave	1805	"	1815
Big Lime	1815	"	1905
Big Injun Sand	1905	"	2155
Gordon "Stray"	2670	"	2690
Pencil cave	2690	"	2700
Gordon Sand	2720	"	2750
Fourth Sand (gas)	2766		
Total depth	2781		
(Fair gas well.)			

In 1902 a large oil well (200 to 300 barrels) was completed by the South Penn Oil Company on the Mary E. White farm, near Dulany Postoffice on Dulany run, a tributary of Little Fishing creek, while early in 1903 another good well was drilled in on the A. G. Sidell farm, located on Steeles run, more than a mile north from the White farm. The oil is found in both the

"Stray" and "Gordon" Sands of Wetzel, and these two developments (which are classed under the head of "Pine Grove field" in the oil well literature, although six to seven miles northeast from the town of Pine Grove) have led to the opening of a large and productive pool, mainly on the waters of Steeles run, a tributary of Little Fishing creek.

The following four records are from wells in the Steeles run pool:

W. D. Pool Well, No. 1.

Two miles northeast of Wileyville, Center district. Authority, South Penn Oil Company. (Steel line.)

	Feet.		Feet.
Pittsburg Coal	1010	"	1015
Dunkard Sand	1500	"	1530
Salt Sand	1850	"	1900
Maxton Sand	2000	"	2020
Big Lime	2180	"	2255
Big Injun Sand	2255	"	2460
"Stray" Sand	3040	"	3067
Gas and oil, 3048′ (second pay, 3059′).			

Sidell-Moore (John W. Moore) Well, No. 1.

Two and one-half miles east of Wileyville, Center district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1280	to	1287
Dunkard Sand	1760	"	1790
Salt Sand	2030	"	2230
Pencil cave	2430	"	2435
Big Lime	2435	"	2495
Big Injun Sand	2495	"	2730
"Stray" Sand (oil, 3340′)	3321	"	3342
Gordon Sand (oil, 3345′)	3343	"	3358
(Twelve-barrel well.)			

Sidell-Moore (John W. Moore) Well, No. 2.

Center district. Authority, South Penn Oil Company

(Steel line.)	Feet.		Feet.
Coal (Washington)	550		
Pittsburg Coal	1025		
Dunkard Sand	1525	"	1575
Salt Sand	1800	"	2100
Little Lime	2150	"	2180
Pencil cave	2180	"	2190
Big Lime	2190	"	2250
Big Injun Sand	2250	"	2490
"Fifty-foot" Sand	2850	"	2890
"Stray" Sand (oil, 3062′)	3052		

Gordon Sand (oil, 3074′)	3073	"	3083
(Forty-five barrel well.)			

J. A. Lemasters (Jonah Morris) Well, No. 1.

One mile and a half northeast of Wileyville, Center district. Authority, South Penn Oil Company.

	Feet.		Feet.
"Native" Coal (Waynesburg)	791	to	795
Pittsburg Coal	1100	"	1105
Dunkard Sand	1580	"	1660
Salt Sand	1915	"	1955
Maxton Sand	2135	"	2145
Pencil cave	2243	"	2253
Big Lime	2253	"	2310
Big Injun Sand	2310	"	2535
"Stray" Sand (gas and oil, 3134′)	3132	"	3157
(Fifteen-barrel well.)			

A. H. Jackson Well, No. 2.

One mile southeast of Dean Postoffice, Center district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1060	to	1067
Dunkard Sand	1530	"	1595
"Gas" Sand	1715	"	1760
Salt Sand	1820	"	2115
Little Lime	2225	"	2250
Pencil cave	2250	"	2256
Big Lime	2256	"	2320
Big Injun Sand	2320	"	2545
"Stray" Sand (oil, 3116′)	3106	"	3133
Gordon Sand	3134	"	3149
Total depth	3157		

Lida Lemasters Well, No. 3.

One mile and a half northeast of Wileyville, Center district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal (Washington)	632		
Pittsburg Coal	1066		
Dunkard Sand	1555	to	1625
Salt Sand	1885	"	2030
Big Lime	2213	"	2285
Big Injun Sand	2310	"	2540
Stray Sand	3094		
Gordon Sand (gas and oil, 3105′)	3101	"	3116
(Twenty-barrel well.)			

R. J. Postlethwait Well, No. 3.

Three miles east of Wileyville, Center district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal, Washington	750	to	754
Pittsburg Coal	1200	"	1207
Dunkard Sand	1665	"	1700
Salt Sand	1925	"	2136
Maxton Sand	2280	"	2290
Pencil cave	2350	"	2355
Big Lime	2355	"	2410
Big Injun Sand	2410	"	2690
"Stray" Sand (dry)	3227	"	3228

Peter Postlethwait Well, No. 2.

Three miles east of Wileyville, Center district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal, "Native"	715		
Pittsburg Coal	1190		
Dunkard Sand	1680	"	1730
Salt Sand	1975	"	2250
Little Lime	2300	"	2330
Pencil cave	2330	"	2340
Big Lime	2340	"	2400
Big Injun Sand	2400	"	2630
"Fifty-foot" Sand	3015	"	3060
"Stray" Sand	3225		
Gordon Sand (oil, 3253′)	3250	"	3270
(Ten-barrel well.)			

T. J. Showalter Well, No. 2.

Four miles northeast of Wileyville, Center district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1075	to	1081
Dunkard Sand	1580	"	1630
Salt Sand	1805	"	2100
Big Lime	2265	"	2305
Big Injun Sand	2305	"	2540
Stray Sand (gas, 3117′)	3115	"	3129
Gordon Sand (oil, 3135′)	3131	"	3157
Total depth	3162		
(Twenty-barrel well.)			

T. J. Showalter Well, No. 4.

Four miles northeast of Wileyville, Center district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1205		
Dunkard Sand	1685	to	1725
Salt Sand	2000	"	2145
Big Lime	2390	"	2440
Big Injun Sand	2445	"	2695
Stray Sand (gas, 3236′)	3234	"	3251
Gordon Sand	3259	"	3267
Total depth	3413		

J. R. Shreve Well, No. 12.

Three miles northeast of Pine Grove. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	920	"	927
Dunkard Sand	1400	"	1430
Salt Sand	1760	"	1860
Maxton	1950	"	1980
Pencil cave	2000	"	2005
Big Lime	2005	"	2065
Big Injun Sand	2065	"	2385
"Fifty-foot" Sand	2800	"	2820
Stray Sand	2960	"	2992
Gordon Sand (oil, 2995′)	2992	"	3011

(One hundred and fifty-barrel well.)

On the high divide between the waters of Big and Little Fishing creeks, and about four miles northeast from Pine Grove, the greatest thickness of measures above the Pittsburg coal, of any well yet reported from the Appalachian field, was found on the land of John H. Rush. The well starts near the summit of a high knob, and the record reads as follows:

John H. Rush Well, No. 3.

Four miles northeast of Pine Grove. Authority, Kanawha Oil Company.

	Feet.
Pittsburg Coal	1410
Big Injun	2650
Stray Sand	3415
Gordon Sand	3445
Total depth	3460

It is practically certain that at no other point in the Appalachian basin could the thickness of strata overlying the Pittsburg coal exceed the above by more than 40 to 50 feet, and as the Waynesburg coal overlies the Pittsburg bed about 300 feet in the region, this would give 1,100 to 1,150 feet for the maximum thickness of the Permian or Dunkard series in this county.

T. H. Alley Well, No. 1.

Near Pine Grove. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	745	to	752
Dunkard Sand	1260	"	1320
Salt Sand	1600	"	1650
Little Lime	1900	"	1930
Pencil cave	1930	"	1940
Big Lime	1940	"	2000
Big Injun Sand	2000	"	2240
"Fifty-foot" Sand	2550	"	2600
Red rock	2675	"	2695
Gordon "Stray" (gas, 2785′ and 2822′)	2785	"	2822

Mills Well, No. 1.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.		Feet.
Ten-inch casing	330		
Pittsburg Coal	540		
Eight and one-fourth-inch casing	1043		
Salt Sand	1250	"	1475
Six and five-eighths-inch casing	1492		
Pencil cave	1774		
Limestone	1790	to	1870
Big Injun Sand	1870		
Five and three-sixteenths-inch casing	1877		
First oil	1894		
First "Break"	1950		
Slate	1970		
Second pay and flowed	1980		
Finished	2040		

Mills Well, No. 5.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.	Feet.
Ten-inch casing	235	
Pittsburg Coal	650	
Eight and one-fourth-inch casing	1200	
Big Injun Sand	1955	

Oil show at	2050		
Six and five-eighths-inch casing	2090		
Top of Stray	2715		
Five and three-sixteenths-inch liner 606 feet at	2715		
Gordon Sand	2740	to	2755
Total depth			2757

Mills Well, No. 7.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.		Feet.
Pittsburg Coal	635		
Ten-inch casing	330		
Eight and one-fourth-inch casing	1190		
Top of Big Injun Sand	1930		
Show of oil	2035		
Six and five-eighths-inch casing	2045		
Five and three-sixteenths-inch casing (560′)	2130	to	2690
"Stray" Sand	2690		
Gordon pay	2715	"	2723
Bottom Gordon Sand			2728
Bottom of hole			2729

Mills Well, No. 9.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.	Feet.
Pittsburg Coal		805
Ten-inch casing		460
Eight and one-fourth-inch casing		1360
Top of Big Injun Sand		2105
Show of oil		2195
Six and five-eighths-inch casing		1850
Five and three-sixteenths-inch casing		2450
Four-inch liner, 3 sections, 404′ from 2476′ to 2880′		
Top "Stray" Sand		2880
Top of Gordon Sand (oil, 2899′)		2895
Bottom of Sand		2906
Bottom of hole		2907

Mills Well, No. 11.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.	Feet.
Pittsburg Coal —	785	
Ten-inch casing	560	
Eight and one-fourth-inch casing	1555	
Top of Big Injun Sand	2095	
Oil at	2190	

Six and five-eighths-inch casing	2128	
Five and three-sixteenths-inch liner (591′) from	2264	to 2855
Top of "Stray" Sand	2855	
Break between "Stray" and Gordon	8	
Gordon Sand, top	2883	
Bottom of pay	2890	
Bottom of Sand	2897	
Bottom of hole	2902	

Mills Well, No. 14.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.	Feet.
Pittsburg Coal	885	
Ten-inch casing	480	
Eight and one-fourth-inch casing	1400	
Big Injun Sand	2140	
Six and five-eighths-inch casing	2259	
Show of oil Big Injun Sand	2275	
Five and three-sixteenths-inch liner, 4 sections, 605′ from	2294	to 2909
Stray Sand	2908	" 2924
Break, Stray and Gordon	10	
Top Gordon Pay	2934	
Bottom of pay	2953	
Bottom of Sand	2953	
Bottom of well	2954	

Mills Well, No. 23.

Piney Fork. Authority, E. H. Jennings & Brothers.

	Feet.
Pittsburg Coal	920
Ten-inch casing	460
Eight and one-fourth-inch casing	1400
Six and five-eighths-inch casing	2215
Top of Big Injun Sand	2220
Oil and water	2335
Five and three-sixteenths-inch casing	2382
Top of "Stray" Sand	3007
Oil and Gas in "Stray"	3020
Gordon Sand	3028
Pay (Gordon)	3030
Bottom of Sand	3044
Bottom of hole	3050

Mills Well, No. 63.

Piney Fork.

	Feet.
Pittsburg Coal	705

Maxton Sand (gas)	1730
Big Injun Sand	2005
Stray Sand	2782
Gordon Sand	2804
Oil	2808

Mary J. Reilly Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1065		
Big Injun Sand	2390	to	2540
"Stray" Sand	3141		
Gordon Sand (oil, 3170')	3161	"	3176
Bottom	3187		

John J. Reilly Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	740		
Big Injun Sand	2050	to	2200
"Stray" Sand	2778	"	2798
Gordon Sand (oil, 2820')	2798	"	2830
Total depth	2876		

John J. Reilly Well No. 3.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	917		
Big Injun Sand	2270	to	2380
"Stray" Sand (oil, 2990')	2985		
Gordon Sand (oil, 3002')	3000	"	3019

Jas. A. Booth Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	660		
Big Injun Sand	1985	to	2160
"Stray" Sand (oil, 2766')	2763		
Gordon Sand (oil, 2781')	2775	"	2792
Total depth			2808

Jas. A. Booth Well, No. 2.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	880		
Big Injun Sand	2205	"	2355
"Stray" Sand (oil, 2865')	2860		
Gordon Sand (oil, 2888')	2880	"	2890
Total depth	2901		

F. R. Ball Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Washington)	140		
Coal (Waynesburg?)	400		
Dunkard Sand	1060		
"Gas" Sand	1125		
Salt Sand	1540		
Little Lime	1850		
Pencil cave	1880		
Big Lime	1890		
Slate and Sand (Keener)	1968		
Big Injun Sand (oil and water, 2060′)	1983	to	2110
Slate "Break"	2085		
Total depth	2121		

F. R. Ball Well, No. 2.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	650		
Big Injun Sand (oil, 2050′)	1960	to	2110
"Stray" Sand	2690	"	2706
Gordon Sand (oil, 2712′ and 2720′)	2706	"	2732

F. R. Ball Well, No. 4.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	940		
Big Injun Sand (oil, 2275′)	2240	to	2400
"Stray" Sand	2975	"	2986
Gordon Sand (oil, 3002′)	2989	"	3012
Total depth	3024		

Mary A. Penick Well, No. 2.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	935		
Big Injun Sand	2237	to	2410
"Stray" Sand	3001		
Gordon Sand (oil, 3028′)	3026	"	3048

Anderson Wiley Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	725		
Big Injun Sand	2036	to	2189
"Stray" Sand (gas, light, 2803′)	2789		
Gordon Sand (oil, 2816′)	2812	"	2825
Total depth	2831		

George Wiley Well, No. 1.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	733		
Big Injun Sand	2074	to	2117
"Stray" Sand (gas, 2783')	2771		
Gordon Sand (oil, 2822')	2820	"	2833
Total depth	2835		

McCoy Heirs' Well, No. 4.

Piney Fork. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	845		
Big Injun Sand	2170	to	2320
"Stray" Sand (gas, 2905')	2895		
Gordon Sand (oil, 2928')	2926	"	2935
Oil	2928		
Total depth	2940		

J. R. Wood Well, No. 1.

One mile and a half southwest of Reader Postoffice. Authority, Hope Natural Gas Company.

	Feet.		Feet.
No Pittsburg Coal.			
Maxton Sand	1910	to	1950
Pencil cave	1950	"	1960
Big Lime	1960	"	2020
Big Injun Sand	2020	"	2280
Show oil	2280		
Gordon "Stray" (gas, 2867')	2862	"	2868
Gordon Sand (gas, 2872')	2871	"	2880
Total depth	3037		

The Garner oil pool of Wetzel county was developed by the South Penn Oil Company, its first well having been drilled in 1899 on the land of Henry Garner in Proctor district, which occupies the northwestern corner of the county. This pool has proven very prolific, and has now been traced northeastward by the drill into Marshall county and nearly to the B. & O. R. R., near Loudenville.

Lying as this belt does within five miles of the Ohio river at the nearest point, the westward thinning of the underground strata has diminished the interval between the Pittsburg coal and the Gordon Sand by about 100 feet, so that it measures only 2,000 feet, instead of 2,100 as in the region of the Pine Grove pool,

10 miles east from the Garner developments, as shown by the records which follow:

J. P. Cooper Well, No. 1.

Proctor district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Native Coal (Waynesburg "A")	334	to	338
Mapletown Coal	580	"	583
Pittsburg Coal	675	"	681
Salt Sand	1400	"	1445
Maxton Sand	1675	"	1720
Big Lime	1735	"	1810
Big Injun Sand	1810	"	2012
Berea (?) Sand	2407	"	2420
"Stray" Sand	2639	"	2645
Gordon Sand (gas, 2682′)	2681	"	2700
Rock pressure, 825 pounds.			

J. W. Palmer Well, No. 2

Proctor district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	335	to	339
Mapletown Coal	700	"	702
Pittsburg Coal	785	"	791
Salt Sand	1520	"	1570
Big Lime	1885	"	1925
Big Injun Sand	1925	"	2195
Stray Sand	2756	"	2759
Gordon Sand	2796	"	2814
Total depth			2817

Henry Garner Well, No. 3.

Proctor district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg "A")	590	to	594
Mapletown Coal	850	"	852
Pittsburg Coal	950	"	956
Salt Sand	1670	"	1714
Big Lime	2117	"	2157
Big Injun Sand	2157	"	2423
"Stray" Sand	2921	"	2932
Gordon Sand	2971	"	2980

Henry Garner Well, No. 16.

Proctor district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	480	to	484
Mapletown Coal	840	"	846
Pittsburg Coal	930	"	935

Salt Sand	1668	"	1726
Big Lime	2030	"	2084
Big Injun Sand	2084	"	2360
Gordon Sand (oil, 2959′)	2959	"	2978

Henry Garner Well, No. 29.

Proctor district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	460	to	464
Mapletown Coal	827	"	829
Pittsburg Coal	912	"	918
Salt Sand	1670	"	1730
Big Lime	2010	"	2060
Big Injun Sand	2060	"	2100

John Widner Well, No. 1.

Magnolia district. Authority, South Penn Oil Company.

	Feet.		Feet.
Mapletown Coal	660	to	665
Pittsburg Coal	750	"	755
Big Dunkard Sand	1310	"	1380
Salt Sand	1498	"	1638
Big Lime	1890	"	1940
Big Injun Sand	1940	"	2180
Shells	2450	"	2455
Gordon Sand	2771	"	2773
Total depth	2843		

MARSHALL COUNTY WELL RECORDS.

Marshall county lies directly north from Wetzel, and hence is within the zone of oil and gas production. This county did not receive much attention from the oil fraternity until after the Garner oil pool of Wetzel county had been opened. True, the great gas field in the region of Cameron had been developed in the early '90's, but as the Garner oil pool of Wetzel county was not discovered until 1899, it was late in 1901 before there was much oil production from the extension of this pool northeastward into Marshall. Now that this pool has been extended from the Wetzel county line for a distance of 10 miles through Marshall to the B. & O. R. R., near Loudenville, it is possible that good oil producing territory will yet be found still farther to the north, so that there may be a considerable area of oil territory yet undeveloped within the county.

The following records of wells drilled in different regions of the county will show the general underground succession of the strata in Marshall county. The coal termed "Native" in the records is in nearly all cases the Washington bed of the Permian or Dunkard series, while the "Mapletown" is the drillers name for the Sewickley bed:

Lindsey Burley Well, No. 1.

One-half mile west of Bellton, Liberty district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1100	to	1108
Dunkard Sand	1580	"	1640
Salt Sand	2000	"	2050
Maxton Sand	2230	"	2240
Big Lime	2250	"	2305
Big Injun Sand	2305	"	2590
Berea? Sand	2800	"	2820
"Thirty-foot" Sand	3000	"	3030
Gordon Sand (gas)	3175	"	3185
Fourth Sand (oil, 3210′)	3208	"	3216
Total depth	3225		

J. H. Mackey Well, No. 1.

Near Garrett, Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	745		
"Gas" Sand	1450	to	1550
Salt Sand	1840	"	1915
Big Injun Sand (gas and show of oil 2025′)	1920	"	2230
"Fifty-foot" Sand (Gantz and "Fifty-Foot")	2540	"	2640
"Stray" Sand	2804	"	2812
Red rock	2812	"	2815
Slate	2815	"	2820
Gordon Sand	2820	"	2845
Slate	2845	"	2875
Fourth Sand	2875	"	2885
Slate	2885	"	2935
Fifth Sand	2935	"	2942
Slate and shell	2942	"	3249
Bottom (Dry)			3249

The sand identified by the driller as the "Fifty-foot" in this record represents the Gantz Sand also, and the two combined

make up the "Hundred-foot" of the Butler-Venango county group of sands, so that in this record we have the entire Venango series represented, its top coming 1800 feet below the Pittsburg coal, the same as at Washington, Pennsylvania, 40 miles northeast. The thickness of the series from the top of the Gantz Sand to the bottom of the Fifth Sand (2540-2942) foots up 402 feet, as against 403 feet for the same measures in the type section record from the McDonald pool, given on pages 112-114.

J. A. & S. L. Chambers Well, No. 1.

Two miles southwest of Cameron, Liberty district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Native coal	512	to	515
Mapletown Coal	710	"	715
Pittsburg Coal	800	"	806
Salt Sand	1550	"	1745
Big Lime	1875	"	1915
Big Injun Sand	1915	"	2140
Red rock	2615	"	2675
Gordon Sand (gas, 2792′ and 2804′)	2785	"	2805
Total depth	2810		

Christian Lough Well, No. 3.

One mile west of Cameron, Liberty district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal, native	540	to	545
Mapletown Coal	795	"	800
Pittsburg Coal	890	"	895
Salt Sand	1625	"	1825
Big Lime	1960	"	2000
Big Injun Sand	2000	"	2260
"Stray" Sand	2840	"	2845
Gordon Sand	2885	"	2911
"Pay" streak	2888	"	2898
Total depth	2913½		

Booher-Hicks Well, No. 3.

About three miles northeast of Adaline Postoffice. Authority, Benedum Brothers.

	Feet.		Feet.
Pittsburg Coal	950	to	960
"Murphy" Sand (Connellsville)	1065		
First Salt Sand	1720	"	1770
Second Salt Sand	1815	"	1870

Maxton Sand (water)	1970		
Big Lime	2050	"	2100
Big Injun Sand (salt water, 2185′)	2100	"	2365
Berea (Gantz?) Sand	2690		
Gordon Sand (oil, 2950′)	2944	"	2970
(One hundred-barrel well.)			

John Bruhn Well, No. 1.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal	420	to	424
Mapletown Coal	735	"	740
Pittsburg Coal	835	"	840
Little Dunkard Sand	1185	"	1215
Big Dunkard Sand	1325	"	1405
Salt Sand	1730	"	1785
Maxton Sand	1870	"	1905
Big Lime	1905	"	1940
Big Injun Sand	1940	"	2180
Gordon Sand (1st pay, 2834′; 2d pay, 2847′)	2828	"	2857
Total depth			2860

John Bruhn Well, No. 2.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal	740	to	745
Mapletown Coal	1000	"	1002
Pittsburg Coal	1090	"	1096
Little Dunkard Sand	1406	"	1436
Big Dunkard Sand	1606	"	1626
Salt Sand	2005	"	2040
Big Lime	2150	"	2185
Big Injun Sand	2185	"	2430
"Stray" Sand	3050	"	3060
Gordon Sand	3085	"	3100
Total depth	3108		

John Bruhn Well, No. 3.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native coal	520	to	524
Mapletown Coal	750	"	752
Pittsburg Coal	860	"	866
Salt Sand	1700	"	1790
Big Lime	2040	"	2100
Big Injun Sand	2100	"	2340
Gordon Sand	2849	"	2879
Total depth			2889

A. L. Courtright Well, No. 1.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native coal (Washington)	298	to	302
Mapletown Coal	558	"	560
Pittsburg Coal	648	"	654
Salt Sand	1430	"	1660
Big Lime	1690	"	1750
Big Injun Sand	1750	"	2025
Gordon Sand	2632	"	2656

Lewis Chambers Well, No. 1.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Jollytown)	150	to	153
Second Coal (Washington)	400	"	404
Mapletown Coal	730	"	735
Pittsburg Coal	820	"	824
Little Dunkard Sand (Saltzburg)	1120	"	1140
Big Dunkard Sand	1305	"	1350
Salt Sand	1430	"	1770
Maxton Sand	1865	"	1895
Big Lime	1910	"	1954
Big Injun Sand	1954	"	2200
"Stray" Sand	2790	"	2796
Gordon Sand	2814	"	2844

Thompson Heirs' Well, No. 1

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Dunkard Sand	1107	to	1117
"Gas" Sand	1340	"	1410
Salt Sand	1510	"	1560
Big Lime	1945	"	1995
Big Injun Sand	1995	"	2150
Gordon Sand (oil, 2865½')	2850	"	2900

Gustav Richter Well, No. 1.

Liberty district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	725	to	729
Mapletown Coal	985	"	987
Pittsburg Coal	1075	"	1081
Salt Sand	1905	"	2035
Big Lime	2145	"	2195
Big Injun Sand	2195	"	2440
Gordon Sand	3064	"	3084
Bottom			3096

John Cain Well, No. 1.

About two miles southwest of Adaline. Authority, Benedum Brothers.

	Feet.		Feet.
Pittsburg Coal	745	to	750
Cow Run Sand	1145	"	1150
First Salt Sand	1400	"	1425
Second Salt Sand	1590	"	1615
Maxton Sand	1770	"	1790
Big Lime	1840	"	1900
Big Injun Sand (gas, 1917′)	1900	"	2160
"Fifty-foot" Sand	2510	"	2520
Gordon Sand (oil, 2729′)	2729	"	2750
Total depth	2869		
(Good oil well.)			

Joseph Nolte Well, No. 1.

About three to four miles southwest of Adaline. Authority, Benedum Brothers.

	Feet.		Feet.
Pittsburg Coal	1076		
"Murphy" Sand	1113		
Cow Run Sand	1600		
Big Lime	2140		
Big Injun Sand	2226	to	2496
"Stray" (none).			
Gordon Sand (oil, 3075′; gas, 3085′)	3070	"	3085

Gertrude Stein Well, No. 5.

At St. Joseph Postoffice, Meade district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Mapletown Coal	835	to	838
Coal (Redstone)	885	"	890
Pittsburg Coal	920	"	930
Salt Sand	1570	"	1890
Big Lime	1990	"	2040
Big Injun Sand	2040	"	2310
"Stray" Sand	2885	"	2890
Gordon Sand (oil, 2930 to 2940′)	2925	"	2942
Total depth	2945		

Margaret Hartley Well, No. 4.

Two miles northeast of St. Joseph, Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	615	to	620

Mapletown Coal	835	"	840
Pittsburg Coal	955	"	965
Salt Sand	1700	"	1805
Big Lime	2020	"	2059
Big Injun Sand	2059	"	2370
"Stray" Sand	2934	"	2939
Gordon Sand (oil, 2956 to 2965')	2954	"	2969
Total depth	2974		

J. C. Cain Well, No. 7.

Two miles northeast of St. Joseph, Meade district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Native Coal (Waynesburg)	430	"	435
Mapletown Coal	637	"	642
Pittsburg Coal	720	"	728
Salt Sand	1640	"	1680
Big Lime	1772	"	1827
Big Injun Sand	1827	"	2105
"Stray" Sand	2677	"	2680
Gordon Sand (oil, 2720 to 2735')	2717	"	2737
Total depth	2747		

W. H. Dobbs Well, No. 3.

Two miles north of Adaline, Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	466	to	471
Mapletown Coal	710	"	714
Pittsburg Coal	800	"	804
Salt Sand	1370	"	1685
Big Lime	1895	"	1930
Big Injun Sand	1930	"	2175
"Stray" Sand	2725	"	2730
Gordon Sand	2764	"	2795
First "pay"	2768	"	2772
Second "pay"	2788	"	2792
Total depth	2798		

A. J. Frohnapfel Well, No. 5.

One-half mile northwest of St. Joseph, Meade district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Native coal	535	to	540
Mapletown Coal	760	"	765
Pittsburg Coal	850	"	857
Salt Sand	1600	"	1755
Big Lime	1947	"	1987

Big Injun Sand	1987	"	2247
"Stray" Sand	2807	"	2809
Gordon Sand (oil 2855 to 2865')	2850	"	2870
Total depth	2875		

Breiding Heirs' Well, No. 7.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	515	to	520
Mapletown Coal	762	"	767
Pittsburg Coal	852	"	862
Salt Sand	1600	"	1780
Big Lime	1950	"	2040
Big Injun Sand	2040	"	2260
"Stray" Sand	2833	"	2838

Breiding Heirs' Well, No. 2.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native coal	625	to	630
Mapletown Coal	845	"	850
Pittsburg Coal	935	"	945
Salt Sand	1680	"	1800
Big Lime	2000	"	2040
Big Injun Sand	2040	"	2350
"Stray" Sand	2890	"	2895
Gordon Sand	2825	"	2943
Total depth	2949		

G. W. Bowers Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	204	to	209
Mapletown Coal	412	"	414
Pittsburg Coal	500	"	506
Salt Sand	1290	"	1470
Big Injun Sand	1682	"	1920
Gordon Sand	2487	"	2514

John Blaker Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Jollytown)	170	to	173
Waynesburg Coal	415	"	421
Pittsburg Coal	710	"	715
Sand (Morgantown)	852	"	870
Little Dunkard Sand (Saltzburg)	1015	"	1035
Big Dunkard and Salt Sand	1165	"	1560
Maxton Sand	1605	"	1645

Big Lime	1784	"	1840
Big Injun Sand	1840	"	2070
Stray Sand	2685	"	2712
Gordon Sand	2733	"	2736
Fifth Sand	2825	"	2832

Adolph Breiding Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	550	to	555
Mapletown Coal	800	"	805
Pittsburg Coal	895	"	905
Salt Sand	1650	"	1820
Big Lime	1960	"	2000
Big Injun Sand	2000	"	2310
Stray Sand	2870	"	2875
Gordon Sand	2891	"	2906

Alley & Lewis Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	312	to	317
Mapletown Coal	520	"	522
Pittsburg Coal	608	"	614
Salt Sand	1390	"	1583
Big Injun Sand	1740	"	1980
Gordon Sand (oil 2598 and 2605′)	2598	"	2621

Alley & Lewis Well, No. 2.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	605	to	611
Pittsburg Coal	893	"	899
Salt Sand	1668	"	1825
Big Injun Sand	2010	"	2215
Gordon Sand	2881	"	2908

Alley & Lewis Well, No. 3.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	184	to	189
Mapletown Coal	392	"	394
Pittsburg Coal	480	"	486
Salt Sand	1262	"	1455
Big Injun Sand	1612	"	1840
Gordon Sand	2467	"	2477

A. S. Leach Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	487	to	492
Mapletown Coal	685	"	688
Pittsburg Coal	775	"	781
Salt Sand	1550	"	1707
Big Injun Sand	1895	"	2100
Gordon Sand	2771	"	2798
Total depth	2798		

E. B. Francis Well, No. 1.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Washington)	115	to	118
Mapletown Coal	440	"	449
Pittsburg Coal	520	"	525
Salt Sand	975	"	1075
Big Lime	1550	"	1650
Big Injun Sand	1650	"	1790
Gordon Sand	2524	"	2535
Total depth			2807

S. L. Allen Well, No. 1.

Franklin district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	675	to	680
Sand	1200	"	1300
Big Lime	1700	"	1735
Big Injun Sand	1760	"	2000
Gordon Sand	2610	"	2616

J. M. Parsons Well, No. 369.

One mile west of Pioneer Postoffice, Franklin district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Native Coal (Washington)	554	to	558
Mapletown Coal	870	"	875
Pittsburg Coal	960	"	966
Salt Sand	1690	"	1760
Big Lime	2025	"	2100
Big Injun Sand	2100	"	2365
Red rock	2801	"	2886
Gordon Sand (gas, 2980 to 2990′)	2971	"	2997
Total depth	2999		

Rosebys Rock Well.

Clay district, near Rosebys Rock Station, B. & O. R. R. Authority, Burt Oil Company.

	Feet.		Feet.
Mapletown Coal	272		
Pittsburg Coal	350		
Dunkard Sand	880		
Salt Sand (salt water, 1234′)	1065	"	1376
Big Lime	1425		
Gas (in Big Injun)	1475		
Bottom Sand	1490		
Sand again (Big Injun)	1514		
Salt water at 1532 and 1540′.			
Through Sand (Big Injun)	1670		
Gantz Sand	2130		
Shells and slate to bottom at	2920		

Lem Leach Well, No. 1.

Five miles east of Moundsville, and three-fourths of a mile west of Limestone, Washington district. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal (good)	545	to	552
Cave	635	"	810
Cow Run Sand (Saltzburg)	810	"	830
Dunkard Sand	920	"	950
Salt Sand	1000	"	1300
Maxton Sand (hard)	1440	"	1510
Big Lime	1510	"	1590
Big Injun Sand (water, 1645′)	1590	"	1840
Gantz Sand (hard)	2145	"	2160
Gordon Sand, shells, hard	2440		
Fifth Sand, shells and hard	2590		
Total depth (dry.)	2707		

Mound Coal Co.'s Well, No. 1.

On east edge of Moundsville. Authority, Carter Oil Company.

Sewickley Coal	220	to	227
Cave	380	"	425
Cow Run Sand (hard)	600	"	615
Salt Sand (broken)	880	"	1080
Maxton Sand (hard and water at top)	1200	"	1265
Big Lime, hard	1385	"	1445
Big Injun, hard, show of oil 1450′; gas, 1500′	1450	"	1610
Gordon Sand (shells)	2210	"	2218
Total depth (dry)	2579		

Mound Coal Co.'s Well, No. 2.

On east edge of Moundsville. Authority, Carter Oil Company.

	Feet.		Feet.
Coal, Sewickley	206	to	212
Coal (Pittsburg)	280	"	289
Cave	610	"	810
Salt Sand	905	"	1160
Maxton Sand (water and gas)	1200	"	1226
Big Lime (shells and sand)	1300		
Big Injun Sand (dry)	1325	"	1465

A. L. Burley Well, No. 1.

Webster district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	557		
Fifth Sand (gas, 2680′)	2675	to	2690
Total depth			2756

In the vicinity of Moundsville three different "shallow" oil horizons have been developed, and all have been designated by the term "Cow Run."

Mr. M. Callahan has drilled two or three wells near the mouth of Grave creek, at Moundsville, in one of which he found oil at a depth of 287 feet, 135 feet below the Pittsburg coal. This he calls the *First "Cow Run Sand."* It would be in either the Connellsville or Morgantown sandstone. The other producing horizon he calls the *Second "Cow Run" Sand,* and it occurs at a depth of 623 feet, 469 feet below the Pittsburg coal, and hence would be in the Mahoning sandstone, or *"Dunkard Sand"* of the oil producing series, which is the regular *"First Cow Run" Sand* of other regions. The gravity of these oils is 47½° Baume, as tested from a mixture of the two pumped into the same tank.

About three miles northeast from Moundsville another horizon of *"Cow Run" Sand* oil has been found in a sand which comes at 282 feet below the Pittsburg coal, and extends to 302 feet below the same, and hence occurs in the Saltzburg sandstone horizon. These wells are noted for the production of oil of the lightest specific gravity known anywhere in the country, viz: 63½° B., although found at a depth of less than 600 feet. No regular detailed records have been kept of these shallow wells

around Moundsville, and hence none can be published. Within the last few months a large gas field has been developed in northeastern Marshall by the Virginia Oil and Gas Company of Wheeling, West Virginia. The productive horizon belongs at 700 to 725 feet below the Pittsburg coal, and hence is possibly identical with the "Gas" Sand of Marion and Monongalia counties, which generally represents the extreme top of the Pottsville formation, or Homewood sandstone member of that series, though occasionally it is the Freeport sandstone of the Allegheny formation. In Marshall county the rock in which the gas occurs has been identified with the "Salt Sand" by the drillers. One of these fields is on the South Fork of Wheeling creek, near the mouth of Grandstaff run, three to three and one-half miles south from Elm Grove, and the wells are mostly in Sand Hill district. The following records of wells drilled there have been furnished by Mr. W. S. Shaffer of the Virginia Oil and Gas Company, Wheeling:

Maria Downing Heirs' Well, No. 1.

Three and one-half miles southeast of Elm Grove Postoffice. Authority, Virginia Oil and Gas Company.

	Feet.		Feet.
Shale	15		
Top Lime	42		
Bottom Lime	93		
Coal (Sewickley)	123	to	124½
Pittsburg Coal	211	"	217
First Cow Run Sand (Saltzburg)	517	"	553
Second Cow Run Sand (Dunkard)	708	"	742
Salt Sand	904		

"Gas on top and best well in this field, about 5,000,000 cubic feet and rock pressure 475 pounds."

Silas Davis Well, No. 1.

Three and one-half miles southeast of Elm Grove Postoffice. Authority, Virginia Oil and Gas Company.

	Feet.		Feet.
Top Lime	40		
Pittsburg Coal	221	to	227
First Cow Run Sand (Saltzburg)	527	"	537
Second Cow Run Sand (Dunkard)	723		
Salt Sand	924	"	970

"Struck oil at about 945 feet, and shot with 60 quarts below this depth, which shut off the oil and opened up the gas."

William Miller Well, No. 1.

Three and one-half miles southeast of Elm Grove Postoffice. Authority, Virginia Oil and Gas Company.

	Feet.		Feet.
Shale	10		
Top Lime	38		
Bottom Lime	88		
Coal (Sewickley)	120	to	121½
Pittsburg Coal	206	"	212
First Cow Run Sand (Saltzburg)	512	"	540
Second Cow Run Sand (Dunkard)	708		
Salt Sand	900	"	937
Gas at	937		

"Utilzing the gas for drilling purposes, and being piped to Elm Grove for use. Probably 2,000,000 feet with rock pressure of 260 pounds."

George P. Folmar Well, No. 1.

Three miles southeast of Elm Grove Postoffice. Authority, Virginia Oil and Gas Company.

	Feet.		Feet.
Top Lime	40	to	40
Pittsburg Coal	198	"	202
Cave (water)	300		
First Dunkard Sand (Saltzburg)	500	"	520
Second Dunkard Sand	700	"	740
Salt Sand	900	"	960
"Broken" (shale, etc.)	960	"	1050
Maxton (?) Sand	1050		
Flow of gas at	1050		

"Good flow of gas, but abandoned."

Here the driller has called the Saltzburg sandstone the First Dunkard Sand, and has doubtfully referred the sand at 1,050 feet to the Maxton. It is most probably a member of the Pottsville, above the Maxton horizon. The succession of the rocks both above and below this gas horizon is shown by the record of a well bored by the same company in the Majorsville gas field, at the eastern line of Marshall county, as follows:

E. J. Richmond Well, No. 1.

On Crow creek, near Majorsville. Authority, Virginia Oil & Gas Company:

	Feet.		Feet.
Gravel	20	to	20
Lime	10	"	30
Slate	5	"	35
Lime (water)	11	"	46
Black slate	20	"	66
White lime (hard)	30	"	96
Black slate	20	"	116
Lime and slate	20	"	136
Lime (hard)	23	"	159
Slate	6	"	165
Coal	3	"	168
Slate	20	"	188
Slate and hard lime	30	"	218
Lime	25	"	243
Lime, hard	19	"	262
Slate	13	"	275
Lime, hard	5	"	280
Pittsburg Coal (gas)	7	"	287
Slate	13	"	300
Lime	30	"	330
Red rock	5	"	335
Slate	15	"	350
Lime (hard)	10	"	360
Red rock	10	"	370
Slate	30	"	400
Lime (hard)	10	"	410
Red rock	5	"	415
Slate	20	"	435
Lime	15	"	450
Slate	30	"	480
Red rock	5	"	485
Slate	55	"	540
Red rock	10	"	550
Slate	40	"	590
Slate and lime	20	"	610
Sandstone, white	5	"	615
Slate	5	"	620
Coal (gas) Bakerstown	3	"	623
Slate	17	"	640
Lime	5	"	645
Slate	20	"	665
Red rock	10	"	675
Lime	10	"	685

Slate	65	"	750
Lime and shells	15	"	765
Sandstone, white (Dunkard, U. Mahoning)	30	"	795
Slate	5	"	800
Sandstone	10	"	810
Shells	15	"	825
Sandstone (white, Lower Mahoning)	20	"	845
Slate	5	"	850
Sandstone	25	"	875
Slate	5	"	880
Coal, gas (Lower Freeport?)	3	"	883
Slate	7	"	890
Lime (hard)	10	"	900
Slate	10	"	910
Sandstone	10	"	920
Lime	15	"	935
Sandstone	15	"	950
Slate	10	"	960
Sandstone	20	"	980
Slate	7	"	987
Sand, hard, some salt (Gas Sand)	16	"	1003
Slate	17	"	1020
Shells	5	"	1025
Slate	42	"	1067
Sandstone (black)	5	"	1072
Slate	78	"	1150
Sand (Maxton? of Geo. P. Folmar well).	30	"	1180
Slate	20	"	1200
Slate and shells	20	"	1220
Sandstone, black	10	"	1230
Shells	30	"	1260
Slate	10	"	1270
Sandstone, white (base of Pottsville)	25	"	1295
Slate and shells	20	"	1315
Lime and sandstone (probably true Maxton Sand)	40	"	1355
Slate, black	50	"	1405
Big Lime (sandy)	10	"	1415
Slate	15	"	1430
Big Injun Sand, hard and pebbly	40	"	1470
Shells	30	"	1500
Sandstone (base of Big Injun)	70	"	1570
Slate	70	"	1640
Shells and sandy	40	"	1680
Shale, black	20	"	1700
Slate	100	"	1800
Lime	15	"	1815
Slate	50	"	1865
Lime, hard	20	"	1885

Slate		15	"	1900
Lime (shelly)		25	"	1925
Lime (hard and sandy)		5	"	1930
"Berea Grit?"		4	"	1934
Slate		50	"	1984
Lime and slate		16	"	2000
Slate		40	"	2040
Red rock		10	"	2050
Shells		30	"	2080
Slate		20	"	2100
White slate		25	"	2125
Slate, black		8	"	2133
Sand, gas (plenty)		3	"	2136
Slate		6	"	2142
Slate		98	"	2240
Lime and pebbly sandstone	"Stray" and Gordon.	40	"	2280
White sandstone (hard)		30	"	2310
Shells		30	"	2340
Red rock		5	"	2345
Shells and slate		95	"	2440
Fifth Sand (thin "break" at 2445′)		45	"	2485
Slate		35	"	2520
Red rock		50	"	2570
Shells, black		7	"	2577
Lime and shells		10	"	2587
Bayard Sand, hard, dark		10	"	2597
Slate to bottom		6	"	2603

The sand struck at 987 feet in this well, and holding some salt water, is apparently the gas sand of the wells three miles southeast from Elm Grove, since its top comes at 700 feet below the Pittsburg coal, but its position, 443 feet above the top of the Big Injun Sand struck at 1,430 feet in this well, puts the horizon in the Allegheny formation instead of in the Salt Sand (Pottsville), whose base appears to come at 1,295 feet. If the gas horizon, 700 feet under the Pittsburg coal, is also in the Pottsville, this would make that formation 300 feet thick in this region, which appears excessive, compared with the Allegheny, whose top must have been struck at 845 feet, since that is only 160 feet below the lowest *red bed* of the record. This interpretation would give the Conemaugh formation a thickness of 558 feet, which is in close agreement with the results obtained in contiguous regions.

J. M. Allison Well, No. 1.

Three-fourths of a mile northwest of E. J. Richmond well. Authority, Virginia Oil & Gas Company.

	Feet.		Feet.
Pittsburg Coal	290	"	297
Dunkard Sand, thin	750		
Gas Sand (gas at 1030, increasing to bottom at 1055′)	1015	"	1055

"Good for six to seven million feet, and rock pressure 720 pounds."

This reported rock pressure is very high for the depth, and may possibly be in error.

OHIO COUNTY WELL RECORDS.

Ohio county lies directly north from Marshall, but it has never had any oil or gas production worth mentioning, and hence, but few records are available within its small area.

In Volume I, pages 364 and 365, published in 1898, is given the record of the Boggs Run Well (three miles below Wheeling), the deepest (4,500 feet) boring yet made in West Virginia. The Venango Group of sands had practically disappeared in this well, the last 3,000 feet being practically continuous slate. In this well, however, at a depth of 2,955 feet, 2,615 feet below the Pittsburg coal, a sandy stratum was found which showed traces of oil and gas. This is most probably the horizon of the *Speechley Sand* of Pennsylvania.

In the Central Glass Company's boring on Wheeling creek, near the center of Wheeling (given on page 366, l. c.), the Berea Grit is reported at a depth of 1,605 feet below the Pittsburg coal.

The late Dr. Edward Orton gives in Volume VI, page 405, of the Ohio Survey Reports, the record of a well (Laughlin) drilled in Martins Ferry, just opposite Wheeling, in which two bands of *red rock* are reported from depths of 1,610 and 1,660 feet respectively, and as the derrick floor is about 60 feet below the Pittsburg coal, these *reds* would represent the very persistent *red beds* which underlie the "Fifty-foot" Sand of Marion, Monongalia and other counties to the east, where the uppermost one is seldom found under a depth of 1,975 feet below the Pittsburg

coal, thus revealing a disappearance of 250 to 300 feet of measures between Mannington and Wheeling.

On Wheeling creek, about three miles above its mouth, a well was once bored on the land of the late Judge Thompson, by Messrs. George B. Hill and John D. Scully, of Pittsburg, who report the following record of same:

Judge Thompson Well.

	Feet.		Feet.
Interval from Pittsburg Coal	45	to	45
Drive pipe	41	"	86
Slate	50	"	136
Sand	150	"	301
Red rock	20	"	321
Sand, gray	10	"	331
Red rock	25	"	356
Slate	39	"	395
Coal (Bakerstown)	2	"	397
Slate	148	"	545
Sandstone	100	"	645
Coal	4	"	649
Sand, white	176	"	825
Sand, black, with mineral water	15	"	840
Slate	15	"	855
Sand, white	360	"	1215
Slate and shells	430	"	1645
Red rock	35	"	1680
Slate and shells	355	"	2035
Slate and shells	250	"	2285
Sandstone	20	"	2305
Slate and shells	130	"	2435
White slate to bottom of boring	10	"	2445

The 360 feet of white sand reported from 855 to 1,215 undoubtedly holds a portion of the Pottsville, as well as all of the Big Lime (here sandy) and all of the Big Injun Sand.

BROOKE COUNTY WELL RECORDS.

Brooke county lies directly north from Ohio, and like the latter, has had but little oil or gas developed within its boundary. Some fair gas wells were found in the region of Wellsburg, along the Ohio river, 18 to 20 years ago, but they have long since failed to yield gas in paying quantity, as the sand was thin, and the porosity poor. This gas horizon, as shown by the record of

Barclay Well, No. 1, given on page 367, Vol. I, West Virginia Geological Survey, represents the "Berea Grit" of Ohio, and comes about 1,650 feet below the Pittsburg coal, which crops in the Wellsburg hills, 350 feet above the derrick floor. A few small oil wells have been found in the Berea Grit by the Carter Oil Company, two to three miles northwest from Bethany and three and one-fourth miles southeast from Wellsburg. These wells are situated along the waters of Buffalo creek, and one near the mouth of Mingo run on the Bethany turnpike, gave the following record:

Robert Underwood Well, No. 1.

On Buffalo creek, two miles below Bethany. Authority, Carter Oil Company.

	Feet.		Feet.
Coal	260	"	264
Coal (probably Upper Kittanning)	440	"	445
Salt Sand	650	"	900
Big Lime	920	"	980
Big Injun Sand	980	"	1120
Berea	1488	"	1507
Total depth			1509

"Oil and gas in top of Berea," about 30-barrel well.

The Pittsburg coal is opened in the hills here about 200 feet above the derrick floor, thus making the interval from it to the "*Berea*" of the well 1,700 feet, and from the same coal to the top of the Big Injun Sand 1,200 feet, or practically the same as at Washington, Pennsylvania, where the interval from the Pittsburg coal to the "Gantz" Sand is 1,800 feet. The record of the Underwood well would point to the conclusion that the "Berea" of this well may possibly be identical with the Gantz Sand of Washington county.

Robert Underwood Well, No. 2.

On Buffalo creek, about 500 feet northeast of Robert Underwood, No. 1. Authority, Carter Oil Company.

	Feet.		Feet.
Coal	308	"	312
Salt Sand (water at 760′)	660	"	980
Big Injun Sand, hard	985	"	1150
Berea Grit, oil in top	1497	"	1515
Total depth	1546		

(Five-barrel well.)

McCleary Well, No. 1.

Two and one-half miles northwest of Bethany. Authority, Carter Oil Company.

	Feet.		Feet.
Coal	495	"	500
Salt Sand, water at 795'	695	"	940
Big Injun Sand, hard	1116	"	1240
Total depth	2273		
(Dry.)			

Ada Hindman Well, No. 1.

About two and one-half miles northwest of Bethany. Authority, Carter Oil Company.

	Feet.		Feet.
Coal	550	"	560
Salt Sand	750	"	880
Big Injun Sand	995	"	1135
Berea	1500	"	1515
Total depth	1577		
"Dry hole."			

HANCOCK COUNTY WELL RECORDS.

Hancock county lies directly north from Brooke, and has long had some gas and oil production from the "Berea Grit" of the Ohio series. This county has the distinction of being the first one in the country to utilize natural gas for the manufacture of *carbon black,* a gas well in New Cumberland having been used for that purpose as early at 1864, and continued until the gas was practically exhausted in 1883. This gas occurs in the Berea Grit Sand, about 1,500 to 1,550 feet below the Pittsburg coal, in what appears to correspond to the Butler county, Pa., "Gas Sand," and to what some of the drillers in West Virginia have frequently termed the upper "Thirty-foot Sand." The writer has sometimes thought it possible that this "Berea" of Ohio might represent the Gantz Sand of Pennsylvania and West Virginia, which underlies the Pittsburg coal by an interval of 1,800 to 1,900 feet, the measures having thinned away 250 to 300 feet in passing westward to Brooke and Hancock counties, but as this region is directly in the trend of the measures southwestward from Butler county, Pa., where the "Gas" Sand of that region

is found at the same interval (1,500 to 1,600 feet) below the Pittsburg coal, it appears very probable that in Hancock and Brooke counties, at least, the oil sand known as the "Berea" may represent the latter stratum rather than the Gantz oil sand.

The "Turkey-Foot" oil pool of Hancock county was discovered by the Bridgewater Gas Company on the waters of King creek by a well drilled to the Berea, or Smiths Ferry Sand, on the Brice farm, October 12, 1888. No large producers have yet been found, the wells averaging from five to thirty barrels, but there has been a steady and profitable production ever since the field was first opened, and new wells continue to be drilled. The oil is a beautiful light amber in color, like that at Smiths Ferry, Ohio, and about 49° gravity.

The well records in Hancock are quite lacking in details, and hence do not give much desirable information as to the different members of the formations above the Berea, except that the position of the Big Injun Sand is generally noted, because the casing must go through the latter formation in order to shut off the salt water.

The Fisher Oil Company of Pittsburg, Pa., has drilled several wells along the waters of King creek in the Turkey-Foot field, and the following are some of the records kindly furnished by that company:

Levi Gardner Well, No. 2.

	Feet.
Drive pipe (7⅝″)	115
Casing (5⅝″)	890
Oil Sand (Berea)	1259
Finished at	1296

Levi Gardner Well, No. 3.

	Feet.
Seven and five-eighths-inch casing	112
Five and five-eighths-inch casing	936
Oil sand, 22′ thick	1259
Bottom	1281

James Chambers Well, No. 1.

	Feet.
Drive pipe (7⅝″)	126
Casing (5⅝″)	890

Oil Sand	1212
Through Oil Sand (Berea)	1236
Bottom	1240

James Chambers Well, No. 2.

	Feet.
Drive pipe, 7⅝″	126
Casing, 5⅝″	916
Oil Sand	1185
Through Sand	1208
Finished at	1223

Thomas Peterson Well No. 2.

	Feet.
Drive pipe 7⅝″	95
Casing pipe, 7⅝″	820
Oil sand	1167
Through Oil Sand (Berea)	1189
Finished at	1201

Mercer Well, No. 1.

	Feet.
Casing, 7⅝″	140
Casing, 5⅝″	848
Oil Sand (Berea)	1200
Through Sand	1218
Bottom	1238

Mrs. Wylie Well, No. 1.

	Feet.
Casing, 7⅝″	99
Casing, 5⅝″	916
Oil Sand (Berea)	1234
Bottom of Sand	1257
Bottom of well	1272

Mr. James Murray and Murray and Miller of Chester, Hancock county have operated to a considerable extent for oil in the Turkey-foot field, and they have furnished the Survey the following records:

S. A. Richmond Well, No. 3.

Four and one-half miles southeast of Chester. Authority, James Murray.

	Feet.		Feet.
Coal (probably Middle Kittanning)	350		
"Big" Coal (probably Lower Kittanning)	410		
Salt Sand	514		
Big Injun Sand	740	to	757
Berea Grit	1113	"	1160

"Five-barrel well."

S. A. Richmond Well, No. 4.

Four and one-half miles southeast of Chester. Authority, James Murray.

	Feet.		Feet.
Coal (Mahoning?)	240		
"Big" Coal (Lower Kittanning?)	520		
Salt Sand	610		
Bottom of Big Injun Sand	883		
Berea Sand to bottom of well	1212	to	1254

"Five-barrel well."

J. W. Patterson Well, No. 1.

Four and one-half miles southeast of Chester. Authority, James Murray.

	Feet.		Feet.
"Big" Coal (Upper Kittanning?)	325		
Salt Sand	465	to	510
Bottom Big Injun Sand	760		
Berea Sand to bottom of well	1070	"	1107

"Show of oil in Berea."

Robert Stewart Well, No. 1.

Five miles southeast of Chester. Authority, James Murray.

	Feet.		Feet.
"Big" Coal (Lower Kittanning)	318		
Salt Sand	420	"	490
Big Injun Sand	680	"	720
Berea Grit to bottom of well	1056	"	1090

"Fair gas well in Berea."

W. N. Bell Well, No. 1.

Seven miles southeast of Chester. Authority, Murray & Miller.

	Feet.
Bottom of "Injun"	1030
Top Berea Sand	1325
Total depth	1359

"The Bell wells made about 25 barrels when first drilled."

W. N. Bell Well, No. 2.

Seven miles southeast of Chester. Authority, Murray & Miller.

	Feet.
Bottom of "Injun" Sand	955
Top of Berea Sand ("pay," 1310′ to 1320′)	1296
Total depth	1327

"Made about 25 barrels at first."

W. N. Bell Well, No. 4.

Seven miles southeast of Chester. Authority, Murray & Miller.

	Feet.		Feet.
Bottom of Big Injun Sand	900		
Berea Sand	1253	to	1280
Total depth of well	2266		

"Made about 25 barrels at first."

H. L. Patterson Well, No. 1.

Seven miles southeast of Chester. Authority, James Murray.

Coal (Mahoning, "Groff" vein)	200		
Coal (Lower Freeport "Roger" vein)	340		
Sandstone (Freeport)	370		
"Big" Coal (Lower Kittanning)	450		
Salt Sand	560	to	610
Big Injun Sand	844	"	876
Berea Grit	1183	"	1210

Robert Patterson Well No. 1.

Near Holidays Cove. Authority, James Murray.

	Feet.		Feet.
Coal (Bakerstown?)	90		
"Big" Coal (Lower Freeport, "Roger" vein)	350		
Big Injun Sand	720	to	910
Berea Sand	1240	"	1276
Total depth	1296		

"Dry hole."

In the region of Smiths Ferry, Ohio, just opposite the northern point of Hancock county, where the Berea Sand has produced oil for many years, its interval below the Lower Kittanning coal is 750 feet, and below the Ferriferous (Vanport) limestone, 700 feet, while in Butler county, Pa., the interval from the Ferriferous Limestone to the top of the Gantz, or "Hundred-foot," is 950 to 1,000 feet. In the same county (Butler) the interval from the Ferriferous Limestone to the "Gas" Sand is 750 to 800 feet, and hence, it appears more probable that the "Berea," or producing sand of Hancock county will prove to be identical rather with the "Gas" Sand of Butler, than with the Gantz (upper division of the Hundred-foot).

TYLER COUNTY WELL RECORDS.

Tyler county borders the Ohio river for 15 miles immediately

south from Wetzel county, and extends eastward to the same "dividing ridge" which separates Wetzel from Marion and Harrison counties. Hence it comes within the same zone so wonderfully rich in both oil and gas that characterizes the underlying beds of the latter county, and, therefore, many hundreds, or rather some thousands, of oil and gas borings have already been drilled within the limits of Tyler, and it has probably produced more oil than any other county in the State, although its area is only 300 square miles.

The oil history of this county may be said to have opened with the drilling in of the Stewart farm well on the Ohio side of the river, opposite Sistersville, July 1, 1891, since the drill was soon afterwards sent down to the oil sand on the West Virginia side of the river. This first oil development of the county was in the Big Injun Sand which underlies the Ohio river only about 1,100 feet at Sistersville, and hence the wells could be rapidly completed, so that the production of the field grew rapidly, and at one time, in 1892-3, approached 20,000 barrels daily from both the West Virginia and Ohio sides of the river. One peculiarity of the Big Injun Sand region of Sistersville worthy of note is the fact that the oil occurs mixed with vast quantities of both salt water and gas, the three not having been separated in their rock reservoir, as is the rule, so that when the first well was drilled into the sand on Polecat run, near Sistersville, more than a year previous to the completion of the Stewart well, the former failing to produce oil in paying quantity, was abandoned as unproductive. It was discovered by experience that three-inch tubing, instead of two-inch, was required to enable the pump to exhaust the salt water and permit the oil to come into the wells freely. Then, two years after the "Polecat" well had been abandoned as worthless, its owners put the larger tubing into the same, and, after pumping salt water for a month or more, were rewarded by securing a flowing oil well which produced 500 barrels of oil daily, along with probably twice as much salt water. The explanation of this peculiar mixing of the water, oil and gas in the Sistersville field appears to be found in its geologic struc-

ture. A low anticlinal, or rather quaquaversal (dipping in every direction) uplift passes through the field, and at only one point (a single farm on the Ohio side of the river) does the crest of the fold attain an altitude sufficiently great to lift the reservoir high enough to give sufficient relief for the separation of even the gas from the oil and water, since such vast quantities of all were originally present in the very porous resevoir, the Big Injun Sand being very coarsely pebbly in the Sistersville region.

The Big Injun Sand, which, in Monongalia, Marion, Wetzel and Doddridge, is one massive sandstone from top to bottom with only an occasional "break" of limestone or slate 30 to 40 feet below its uppermost layer, develops a persistent division of slate in the Sistersville region, and as the sand above this "break" first developed productive oil wells on the *Keener farm,* near Sistersville, it thus secured from the oil fraternity the name "Keener" Sand, which the upper portion of the Big Injun formation has ever since retained, so that there are five main producing sands in Tyler county, viz: *"Cow Run,"* or *Dunkard, Maxton, Keener, Big Injun* proper, and *Gordon.* The fine geological guide and "Key rock," the *Pittsburg coal,* a stratigraphical marker so valuable to the driller, as well as to the geologist, in the correlation of the different coal beds, limestones, sands, etc., is largely absent from Tyler county, except along its northeastern border on Wetzel and Tyler, where, although quite thin, it is frequently reported, having thinned away westward, or become so reduced in thickness as to be seldom recognizable by the driller. In the Elk Fork Pool, a coal bed (probably the Sewickley) 100 or more feet above the Pittsburg, has occasionally been identified by the drillers with the Pittsburg bed, but the reference is in error. In eastern Tyler, where the Pittsburg coal is fequently noted, its interval above the Big Injun Sand is about 1,300 feet, and, as the latter is quite persistent, it enables one to fix the horizon of the Pittsburg coal approximátely, and thus to correlate the other formations indirectly with a fair degree of accuracy.

The following well records from the several regions of Tyler

county will illustrate the underground rock succession therein:

John Booher Well, No. 1.

McElroy district. Authority, Devonian Oil Company.

	Feet.		Feet.
Cow Run Sand	980	to	1025
Salt Sand	1380	"	1470
Big Lime	1740	"	1830
Big Injun Sand (gas)	1870		

Lloyd Weekley Well, No. 1.

McElroy district. Authority, Devonian Oil Company.

	Feet.		Feet.
Cow Run Sand	870	"	945
Salt Sand	1000	"	1200
Big Lime	1630	"	1710
Big Injun Sand	1715	"	1787
"Pay"	1777	"	1787

T. J. Buck Well, No. 1.

Near Van Camp, in extreme northern corner of Tyler, Lincoln district. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	40	to	900
Big Lime			1565
"Break" (slate)			1664
Big Injun Sand			1669
Total depth			1722

Beatty Heirs' Well, No. 2.

Northern edge of Tyler, near Bird Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	6	to	638
Cow Run Sand	20	"	1300
Salt Sand	500	"	1432
Maxton Sand	10	"	2020
Big Lime	70	"	2090
Keener Sand	45	"	2160
Big Injun Sand	75	"	2205

Cave at 1050′ and 2075′.

Catherine Fulmer Well, No. 3.

In Elk Fork oil field, Ellsworth district. Authority, Carter Oil Company.

	Feet.		Feet.
Cave			712
Cow Run Sand	5	to	960
Salt Sand	300	"	982

Maxton Sand	15	"	1604
Big Lime	65	"	1683
Keener Sand	32	"	1755

James Eddy Well. No. 7.

In Elk Fork oil field, Ellsworth district. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	250	to	830
Cow Run Sand	20	"	1088
Salt Sand	300	"	1108
Maxton Sand	15	"	1725
Cave	7	"	1780
Keener Sand	28	"	1855
Total depth			1895

Grove Heirs' Well, No. 1.

McElroy district. Authority, Victor Oil and Gas Company.

	Feet.		Feet.
Coal (Elk Lick)	700	to	703
Cow Run Sand	905	"	925
Salt Sand	1100	"	1250
Big Lime	1720	"	1800
Big Injun Sand (no "break")	1803	"	1972
Gordon Sand	2537	"	2548

Since the Big Injun Sand comes at about 1,300 feet below the Pittsburg coal, and the Gordon Sand at 2,030 feet below the same coal in this region, the vein struck at 700 feet in this well would belong about 200 feet under the Pittsburg coal, and hence be identical with the Elk Lick bed of the Conemaugh series.

S. Woodburn Well, No. 1.

Indian creek. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	530	to	534
Cow Run Sand	973	"	993
Salt Sand	1115	"	1430
Big Lime	1740	"	1836
Big Injun Sand (light gasser)	1836	"	1921

B. F. White Well, No. 1.

Indian creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand (second)	1040	to	1080
Salt Sand	1150	"	1250
Big Lime	1650	"	1702
Big Injun Sand (gas, 1702'; oil, 1772'-92')	1702	"	1800
Total depth			1800

Noah Booher Well.

Indian creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand (first)	800	to	830
Second Cow Run Sand	1025	"	1075
Salt Sand	1150	"	1350
Big Lime	1622	"	1702
Big Injun Sand (gas, 1702 and 1775′)	1702	"	1869

D. Stoneking Well.

Indian creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	850	to	1000
Big Lime	1675	"	1720
"Break"	1753	"	1763
Big Injun Sand	1763	"	1856
Gas, strong			1725
First pay	1770	"	1775
Second pay	1782	"	1792
Bottom			1856

S. C. Murphy Well, No. 1.

One mile north of Booher Postoffice, on Indian creek. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal, good	470	to	475
Cow Run Sand	970	"	995
Salt Sand	1264	"	1464
Maxton Sand	1634	"	1641
Big Lime	1710	"	1777
Big Injun Sand	1772	"	1867

Allen Well.

Near Braden Station. Authority, South Penn Oil Company.

	Feet.		Feet.
First Coal (Washington)	35		
Second Coal (Waynesburg "A")	100		
Big Injun Sand	1800	to	1915
First gas, 1830′; second gas, 1905′)			

Samuel McMillan Well, No. 3.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			636
Big Injun Sand	1985	to	2105
Stray Sand	2677	"	2682
Gordon Sand (oil, 2698′)	2682	"	2701

Total depth			2716

Samuel McMillan Well, No. 4.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			685
Big Injun Sand	2015	to	2160
Stray Sand	2725	"	2744
Gordon Sand (oil, 2753′)	2745	"	2764
Total depth			2786

Peter Horner Well, No. 2.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			802
Big Injun Sand	2114	to	2321
Stray Sand	2839	"	2854
Gordon Sand (oil, 2864′)	2859	"	2871
Total depth			2881

Peter Horner Well, No. 3.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			910
Big Injun Sand	2200	to	2400
Stray Sand			2938
Gordon Sand (oil, 2967′)	2965	"	2979

Jacob Underwood Well, No. 4.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.
Pittsburg Coal	615
Big Injun Sand	1935
Total depth	2130

H. S. Underwood Well, No. 1.

Near Doddridge county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			630
Big Injun Sand	1950	to	2125
Stray Sand (smell of oil at 2685′)	2670	"	2687
Gordon Sand (oil, 2690′)	2687	"	2708

Thompson Heirs' Well, No. 1.

McElroy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			665
Big Injun Sand	2015	to	2180
Stray Sand	2734	"	2751
Gordon Sand (oil, 2751′)	2751	"	2760
Total depth			2782

Thompson Heirs' Well, No. 3.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			682
Big Injun Sand (oil, 2035′)	1985	to	2140
Stray Sand	2680	"	2720
Gordon Sand (oil, 2725′)	2722	"	2734
Total depth			2745

O. W. O. Hardman Well, No. 33.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.
Pittsburg Coal	680
Top of Big Injun Sand	1970
First oil and gas	2045
"Pay" to	2055
Bottom	2109

O. W. O. Hardman Well, No. 39.

Tyler county, near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.
Pittsburg Coal	743
Big Injun Sand	2033
Top of "Pay"	2150
Good Sand	2160
Depth of hole	2192
Six and five-eighths-inch casing	2020

O .W .O. Hardman Well, No. 47.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.
Pittsburg Coal	666
Big Injun, top	1956
Gas and oil	2058
"Pay" Sand to	2068
Depth of hole	2089
Six and five-eighths-inch casing	1920

O. W. O. Hardman Well, No. 48.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.
Pittsburg Coal	795
Top Big Injun Sand	2085
Gordon Sand "Pay"	2872
Good Sand	2877
Total depth	2889
Ten-inch casing	280
Eight and one-fourth-inch casing	1250
Six and five-eighths-inch casing	2085
Five and three-sixteenths-inch casing	2300

O. W. O. Hardman Well, No. 52.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.
Pittsburg Coal	1020
Top Big Injun Sand	2320
Gordon Stray Sand	3060
Top Gordon Sand	3080
Top first pay	3087
Good Sand to	3092
Through Sand	3102½
Ten-inch casing	270
Eight and one-fourth-inch casing	1520
Six and five-eighths-inch casing	2430
Five and three-sixteenths-inch casing	2505

R. B. Prickett Well, No. 1.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.	Feet.
Keener Sand	1649	
Show of gas and oil	1671	
Gas and oil	1680	
Water	1690	
Top of Big Injun Sand	1691	
Best Sand	1695	to 1705
Salt water	1752	

R. B. Prickett Well, No. 4.

Near Doddridge county line. Authority, E. H. Jennings & Bros.

	Feet.	Feet.
Top of Keener Sand	1660	
"Pay"	1675	to 1680
Bottom of Keener Sand	1683	
Slate "break"	5	
Big Injun Sand	1688	
Bottom of hole	1692	

Casing, 6¼″..........................1580

Norman Arnett Well, No. 1.

McElroy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	850		
Big Injun Sand (show oil, 2256′)	2160	to	2285
Stray Sand	2913	"	2926
Gordon Sand (oil, 2948′)	2941	"	2952
Total depth	2964		

F. M. Baker Heirs' Well, No. 1.

McElroy district. Authority, South Penn Oil Company.

	Feet.
Pittsburg Coal	680
Big Injun Sand (oil, 2083′)	1970
Total depth	2097

Alpheus Glover Well, No. 1.

Western edge of Gordon Sand pool. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			885
Big Injun Sand	2192	to	2330
Stray Sand (oil, 2445′)	2915	"	2945
Gordon Sand	2950		
Bottom of hole	2975		

Jas. H. Dawson Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Big Injun Sand	2300	to	2450
Stray Sand	3090	"	3105
Gordon Sand (oil, 3120′)	3120	"	3129
Total depth	3139		

Jas. H. Dawson Well, No. 2.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	780		
Big Injun Sand (show of oil, 2150′)	2070	to	2300
Stray Sand	2795	"	2810
Gordon Sand (oil, 2822′)	2819	"	2840
Total depth	2846		

Jasper Lemasters Well, No. 6.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			941

Big Injun Sand	2240	to	2360
Stray Sand	2979	"	3001
Gordon Sand (gas and oil, 3005′)	3003	"	3015
Total depth			3036

F. M. Lemasters Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	685		
Big Injun Sand	2010	to	2167
Stray Sand	2715	"	2731
Gordon Sand (oil, 2735′)	2731	"	2740
Total depth			2753

F. M. Lemasters Well, No. 2.

Authority, South Penn Oil Company.

Pittsburg Coal	647		
Big Injun Sand	1965	to	2130
Stray Sand	2690	"	2702
Gordon Sand (oil, 2709′)	2707	"	2724
Total depth			2728

Mary A. Penick Well No. 5.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			989
Big Injun Sand	2290	to	2460
Stray Sand	3010	"	3027
Gordon Sand (oil, 3033′)	3030	"	3050
Total depth			3056

Jasper N. Glover Well, No. 2.

Western edge of Gordon Sand pool. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			753
Big Injun Sand	2058	to	2223
Stray Sand	2768	"	2793
Gordon Sand (oil, 2799′)	2795	"	2807
Total depth			2818

Elijah Myers Well, No. 6.

McElroy district. Authority, South Penn Oil Company.

	Feet.
Pittsburg Coal	946
Big Injun Sand (1st "pay," 2325′; 2d "pay," 2332′)	2245
Total depth	2368

Mary A. Stealy Well, No. 1.

In Middlebourne, Ellsworth district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	175	to	177
"Hurry Up" Sand (Pittsburg)	315	"	340
Sand	870	"	900
Big Lime	1595	"	1635
Keener Sand (small show gas)	1635	"	1645
Top Big Injun Sand (oil, 1676 to 1683′)	1675		
Total depth	1700		

J. F. King Well, No. 1.

One mile north of Middlebourne, Ellsworth district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal, "native" (Washington?)	190	to	192
Coal (Macksburg?)	382	"	384
"Hurry Up" Sand (Pittsburg sandstone)	545	"	585
Big Lime	1809	"	1845
Keener Sand	1846	"	1874
Big Injun Sand (oil, 1934′; water, 1937′)	1874		
Total depth	1945		

David Hickman Well, No. 1.

One half mile north of Middlebourne, Ellsworth district. Authority, South Penn Oil Company.

	Feet.		Feet.
Bottom Big Injun Sand	1860		
Berea? Sand	2080	to	2095
Lime, shell	2508		
Second pay (Gordon Sand)	2540		
Sand	2708		
Total depth	2875		

William Baker Well, No. 1.

On Little Sancho creek, near Middlebourne. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal, poor	380	to	383
Cave	550	"	760
Cow Run Sand	820	"	835
Salt Sand	920	"	1340
Maxton Sand	1509	"	1549
Big Lime	1564	"	1612
Keener Sand	1612	"	1647
Big Injun Sand	1647	"	1775

This is a very important record, since it reveals the presence of the Pittsburg coal, although quite thin, in a region where it is seldom reported by the drillers, at an interval of 440 feet above the *Cow Run Sand,* 1,129 feet above the *Maxton Sand,* 1,184 feet above the *Big Lime* 1,232 feet above the Keener Sand, 1267 feet above the main solid body of the *Big Injun Sand,* and 1,405 feet above the base of the same. These figures can be used to great advantage in this region for the correlation of the several coal beds, etc. The "Salt Sand" of this record evidently includes nearly all of the Allegheny series.

J. G. King Well, No. 3.

Ellsworth district,. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Native coal (Washington)	208	to	210
Coal (Macksburg?)	395	"	397
"Hurry Up" Sand (Pittsburg)	515	"	540
Big Lime	1807	"	1877
Keener Sand ("pay," 1894 to 1906')	1877	"	1910
Big Injun Sand	1910		
Total depth	1919		

J. K. Hill Well, No. 2.

Elk Fork Pool, near Kidwell Postoffice. Authority, Elk Fork Oil & Gas Company.

	Feet.		Feet.
Big Injun Sand	1927	to	1934
First pay	1934		

Casing—10″, 115′; 8¼″, 1070′; 6⅝″, 1821′.

J. K. Hill Well, No. 4.

	Feet.
Big Injun Sand	1954
First "pay"	1957

J. K. Hill Well, No. 11.

	Feet.		Feet.
Coal (Bakerstown?)	1100	to	1110
Cow Run Sand	1225	"	1325
Maxton Sand	1820	"	1830
Big Lime	1868	"	1958
"Break" above Big Injun Sand	1958	"	1998

"Dry."

J. T. A. Hawkins Well, No. 9.

Elk Fork Pool, near Kidwell Postoffice. Authority, Elk Fork Oil Company.

	Feet.		Feet.
Cow Run Sand	930	to	955
Salt Sand	1200	"	1375
Big Lime	1667	"	1727
Big Injun Sand	1727		
"Pay"	1735		

Near Conaway, in the region northeast from the "Big Moses" gas well in Tyler county (an account of which has been given in Vol. I, page 358) some other very large gas wells have been found in the Big Injun Sand. One of these on the Catherine Haught farm was drilled by the Carnegie Natural Gas Company, the record of which was kindly given by Mr. N. Johnston, Superintendent of that company, as follows:

Catharine Haught Well, No. 1.

	Feet.
Top of Big Injun Sand	1920
Gas at	1998
Total depth	2000
First minute pressure	300 pounds.
Second minute pressure	435 pounds.
Rock pressure	560 pounds.

"Stood at six pounds. "Open pressure" in eight-inch casing. Capacity, 18,000,000 cubic feet daily."

J. G. Mayfield Well, No. 1.

Ellsworth district. Authority, Union Oil Company.

	Feet.		Feet.
Pittsburg Coal	612		
White Lime (Big)	1805	to	1880
White Sand (Big Injun)			1905
Gas at			1963

Israel Folger Well, No. 1.

Elk Fork pool. Authority, South Penn Oil Company.

	Feet.
Pittsburg Coal	None
Big Injun Sand, top	1918
Oil	1926

M. M. Holmes Well, No. 1.

Union district. Authority, Union Oil Company.

	Feet.		Feet.
Ten-inch casing	180		
Eight and one-fourth-inch casing	985		
Six and one-fourth-inch casing	1380		
Keener Sand (oil and gas, 1675 to 1680½')	1675	to	1699

J. L. Ash Well, No. 1.

One-half mile south of Wilbur. Authority, Carter Oil Compnay.

	Feet.		Feet.
Coal, poor	50	to	52
Cave ("Big red")	765	"	980
Cow Run Sand	980	"	995
Salt Sand	1200	"	1245
Salt Sand	1480	"	1515
Maxton Sand	1610		
Big Lime	1765	"	1852
Big Injun Sand	1854	"	1940
Slate	1924	"	1934
Slate to bottom	1965	"	1972

The coal near the top of this well may possibly be the Washington bed, since the Pittsburg bed should occur at about 540 feet in the well.

Chapman Well, No. 1.

Elk Fork pool. Authority, Sun Oil Company.

	Feet.
Coal	242
Coal (Waynesburg "A")	361
Coal (Waynesburg)	425
Maxton Sand, gas	1910
Keener Sand	2045
Top of "pay" (Big Injun)	2130
Bottom of hole	2150

Bumfill Well, No. 1.

Elk Fork pool. Authority, Sun Oil Company.

	Feet.		Feet.
Coal (Macksburg)	265		
Big Injun Sand	1735	to	1747

Bumfill Well, No. 2.

Elk Fork pool. Authority, Sun Oil Company.

	Feet.
Coal (Macksburg)	240
Top Keener	1700

Bumfill Well, No. 3.

Elk Fork pool. Authority, Sun Oil Company.

	Feet.
Ten-inch casing	310
Eight-inch casing	900
Six-inch casing	1710
Coal (Macksburg)	310
Keener Sand, top	1770

Top of "Pay" Sand 1794

Bumfill Well, No. 4.

Kidwell. Elk Fork pool. Authority, Sun Oil Company.

	Feet.		Feet.
Coal (Macksburg)	200		
Keener Sand	1684	to	1701
Total depth			1701

John Seckman Well, No. 2.

About two miles southeast of Centerville, McElroy district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	533	to	535
Cow Run Sand	933	"	985
Salt Sand	1230	"	1280
Maxton Sand	1750	"	1770
Big Injun Sand (oil, 1930′)			1848
Total depth			1961
"Fifty-barrel well."			

R. W. Ash Well, No. 1.

Two miles south of Centerville, Middle Island creek. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Washington?)	95	to	99
Cow Run Sand	1000	"	1020
Salt Sand	1200	"	1400
Big Lime	1900	"	1940
"Break"	1940	"	1970
Big Injun Sand (oil, 2050′)	1970		

A. L. Corbly Well, No. 1.

Near Centerville. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	950	to	965
Salt Sand	1050	"	1110
Maxton Sand	1540	"	1620
Big Lime	1690	"	1760
Big Injun Sand (gas, 1787′; oil, 1810′)	1767	"	1832

Leroy Pierpoint Well, No. 2.

Centerville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	815		
Big Injun Sand (oil and water, 2198′)	2149	to	2202

Leroy Pierpoint Well, No. 1.

Centerville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	800		
Big Injun Sand (oil, 2192′)	2138	to	2199

J. W. Musgrave Well, No. 1.

One mile north of McKim Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cow Run Sand	1154	to	1174
Salt Sand (water, 1480′)	1420	"	1810
Maxton Sand	1998	"	2048
Big Lime	2074	"	2130
Keener Sand	2138	"	2170
Big Injun Sand (gas, 2170′; oil, 2190′)	2170	"	2220
(Two hundred-barrel well.)			

F. T. McCullough Well, No. 3.

One-half mile north of McKim Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg)	543		
Cave	920	to	970
Cow Run Sand	1085	"	1100
Salt Sand	1460	"	1665
Maxton Sand	1815	"	1830
Limestone (hard)	1965	"	2035
Big Injun Sand (oil, 2083′)	2035	"	2083
"Twenty-barrel well."			

J. J. Gorrell Well, No. 1.

Four miles northeast of Meadville, and one mile northwest of Bert Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal, poor	450	to	453
Cave	465	"	765
Cow Run Sand	765	"	800
Salt Sand	1065	"	1365
Cave, water, 1645′	1635	"	1655
Big Lime	1660	"	1731
Big Injun Sand (gas, light, 1793′)	1763	"	1863

F. A. Markle Well, No. 1.

Vicinity of Beech Grove. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Washington?)	115	to	117
Cow Run Sand	950	"	965
Salt Sand	1142	"	1530
Maxton Sand	1630	"	1710

Big Lime	1725	"	1825
Big Injun Sand	1825	"	1980
Total depth			2002

J. G. Smith Well, No. 9.

Plum Run Region. Authority, Victor Oil & Gas Company.

	Feet.		Feet.
Cow Run Sand	1050	to	1068
Salt Sand	1200	"	1550
Big Lime	1860		
Big Injun Sand (gas, 1962'; oil, 1965')	1917	"	1984

W. W. Joseph Well, No. 1.

Plum Run Region. Authority, Devonian Oil Company.

	Feet.
Cow Run Sand	930
Salt Sand	1100
Big Lime	1650
Big Injun Sand	1750
Little gas, 1800 feet.	
Bottom of well	1910

J. G. Smith Well, No. 6.

Plum Run Region. Authority, Victor Oil & Gas Company.

	Feet.		Feet.
Cow Run Sand (show of oil)	1077	to	1095
Salt Sand	1260	"	1610
Big Lime	1872	"	1973
Big Injun Sand (gas, 2013'; oil, 2020')	1973	"	2023
Ten-inch casing	225		
Eight-inch casing	1125		
Six and one-fourth-inch casing	1872		

Bullman Well, No. 5.

Near Wick. Authority, Crawford & Wilson.

	Feet.		Feet.
Salt Sand	1220		
Big Lime	1796		
"Break"	1894	to	1902
Big Injun Sand (oil and gas, 1932')	1902	"	1932

Felix Flesher Well, No. 3.

Near Wick. Authority, Crawford & Wilson.

	Feet.		Feet.
Cow Run Sand	955		
Salt Sand	1100		
Big Lime	1672		
Big Injun Sand (gas and oil, 1777')	1757	to	1777
Ten-inch casing	155		
Eight and one-fourth-inch casing	960		

Six and one-fourth-inch casing 1445

U. T. Freeland Well, No. 1.

Sancho creek. Authority, Carter Oil Company.

	Feet.		Feet.
Show Pittsburg Coal	460		
Salt Sand	950	to	1153
Big Lime	1595	"	1731
"Break"	1731	"	1741
Big Injun Sand (gas, 1780')	1741	"	1836

U. T. Freeland Well, No. 2.

Sancho creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	920	to	940
Salt Sand	1240	"	1340
Big Lime	1672	"	1772
Big Injun Sand	1772	"	1870
"Dry."			

E. C. Freeland Well, No. 2.

Sancho creek. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	300		
Cow Run Sand	900	to	940
Salt Sand	1100	"	1200
Big Lime	1640	"	1740
"Break"	1740	"	1750
Big Injun Sand (gas, 1800'; oil, 1810')	1750	"	1848

Clark Smith Well, No. 1.

Middle Island creek, near Tyler-Pleasants county line. Authority, Carter Oil Company.

	Feet.		Feet.
First Coal (Pittsburg)	300	to	303
Second Coal	360	"	365
Cow Run Sand	765	"	795
Salt Sand, broken.			
Big Lime	1470	"	1575
Big Injun Sand	1575	"	1643

A. P. Allen Well, No. 1.

Middle Island creek, same location as last. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	133	to	137
Cow Run Sand	800	"	840
Big Lime and Keener Sands	1490	"	1566
"Break" (slate)	1566	"	1586

	Feet.		Feet.
Big Injun Sand (gas, 1586′; oil, 1606′)	1586	"	1630

Hardman & Livingston Well, No. 5.

Southwest corner of Tyler, near Hebron Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	435	to	437
Cow Run Sand	1100	"	1120
Salt Sand, broken	...	"	....
Big Lime	1825		
Big Injun Sand (oil and gas in top)	1942	"	1995

A. B. Livingston Well, No. 3.

Plum run of McKim creek, near Hebron, southwest corner of Tyler county. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	500		
Cow Run Sand	1150	to	1190
Salt Sand	1250	"	1450
Big Lime	1900	"	1960
"Break."			
Big Injun Sand	1983	"	2046

B. F. Robinson Well, No. 1.

About two miles east of Falls Mills, Middle Island creek. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg)	362	to	365
Cow Run Sand	862	"	872
Salt Sand	1122	"	1422
Maxton Sand	1512	"	1562
Big Lime	1690	"	1765
Big Injun Sand	1800	"	1910
Total depth			1926

B. F. Robinson Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	700	to	703
Cow Run Sand	1060	"	1075
Salt Sand	1250	"	1550
Maxton Sand	1825	"	1845
Big Lime	1850	"	1910
Big Injun Sand	1937	"	2057

The records of these wells on the B. F. Robinson tract are of very great geologic interest and importance, since they reveal the interval (1,234 feet) between the Pittsburg coal and the main Big Injun oil sand, and also show that the coal found at 362

feet in the No. 1 well, is not the Pittsburg bed (as usally termed by the drillers of the region), but that it belongs approximately 200 feet above the Pittsburg bed, and is probably identical with the Macksburg coal of Ohio, or the Uniontown coal of the Monongahela formation. This coal appears to have a wide distribution in Tyler, Pleasants, Doddridge, etc., and may possibly be identical with the coal mined in the vicinity of St. Marys, immediately under a great ledge of sandstone, and which is identical with the Macksburg coal of Ohio. This bed has been referred by the Ohio geologists to the Sewickley horizon of the Monongahela formation, but it may possibly represent the Uniontown coal of the latter series, since its interval (200 feet) above the Pittsburg coal would appear to be too great for the Sewickley seam.

Elias Wells Well, No. 1.

Two miles south of B. F. Robinson's and one mile north of Meadville. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	600	to	750
Cow Run Sand	900	"	1000
Salt Sand	1200	"	1400
Maxton Sand	1590	"	1605
Big Lime	1665	"	1718
Keener Sand	1718	"	1760
Depth			1762

Elias Wells Well, No. 8.

	Feet.		Feet.
Coal (Macksburg?)	480	to	484
Cow Run Sand	1035	"	1050
Salt Sand	1240	"	1540
Maxton Sand	1680	"	1720
Big Lime	1799	"	1859
Keener Sand	1859	"	1889
Big Injun Sand	1889	"	1989

An oil well has recently been drilled by the Carter Oil Company, two miles south of Wick Postoffice, the record of which was kept with great care by the drilling crew, and a set of the samples was kindly presented to the Survey by Mr. W. H. Aspinwall of the Carter Oil Company. The well begins in the Permian, and found petroleum in the "Big Injun" Sand, so that it penetrated nearly all of the carboniferous system. The record is a very in-

teresting and important one, and is here given in full as follows:

	Feet.		Feet.
Soil and clay	0	to	5
Red rock	5	"	55
Brown shale	55	"	67
Red rock	67	"	90
Sandstone	90	"	150
Green slate	150	"	160
Sandstone, hard	160	"	180
Dark gray slate	180	"	192
Sandstone	192	"	230
Sandstone	...	"	...
Green slate	230	"	234
Red rock	234	"	280
Sandstone, hard	280	"	295
Slate	295	"	305
Slate, **trace of coal at 315′**	305	"	325
Sandstone, micaceous	325	"	410
Red rock	410	"	425
Limestone	425	"	450
Slate	450	"	452
Red rock	452	"	472
Sandstone, gray, coarse	472	"	502
Black slate, **trace of coal at 506′ (Uniontown?)**	502	"	510
White slate	510	"	530
Sandstone	530	"	540
White slate	540	"	542
Red rock	542	"	557
Slate (10-inch casing, 557 feet)	557	"	597
Limestone	597	"	629
Slate	629	"	635
Lime and sand shells	635	"	690
Sandstone	690	"	700
Slate	700	"	710
Limestone	710	"	730
Limestone	730	"	742
Sandstone	742	"	759
Pittsburg Coal?	759	"	760
Sandstone	760	"	800
Sandstone	800	"	806
Lime and sand shells	806	"	856
Limestone, sandy	856	"	881
Sandstone	881	"	893
Black slate, **trace of coal**	893	"	908
Red rock "Big Red"	908	"	960
Limestone, sandy	960	"	990
Coarse sand, **steel line**	990	"	1030

Black slate	1030	"	1046
Limestone, sandy	1046	"	1052
Red rock	1052	"	1058
Limestone and limy shales	1058	"	1140
Limestone	1140	"	1161
Slate	1161	"	1200
Sandstone, hard	1200	"	1212
Shale	1212	"	1237
Sandstone	1237	"	1247
Sandstone	1247	"	1253
Limestone, hard	1253	"	1288
"Break," soft	1288	"	1293
Limestone, hard	1293	"	1299
Freeport sandstone (8″ casing, 1310′)	1299	"	1434
"Break" of black slate, trace of coal at 1464′	1434	"	1464
Salt Sand, Pottsville, water at 1550′	1464	"	1666
Black slate	1666	"	1752
Sandstone	1752	"	1764
Black slate (6⅝″ casing, 1776′)	1764	"	1776
Black grit, very hard and wore bits	1776	"	1826
Shells	1826	"	1836
Maxton Sand	1836	"	1891
Black lime rock	1891	"	1910
Limestone, "Big Lime"	1910	"	1976
"Keener" Sand	1976	"	2008
Big Injun Sand (Steel line, little gas)	2008	"	2095
Gas at 2018′, oil by steel line, 2029′.			
Total depth, steel line			2101

J. L. Poe Well, No. 9.

Two miles south of Wick. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Macksburg?)	660	to	663
Cave	900		
Cow Run Sand	1224	"	1254
Depth			1254

Dorsey Baker Heirs' Well, No. 1.

Near Ritchie county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	985		
Big Injun Sand	2280	"	2420
Stray Sand	2978	"	3008
Gordon Sand	3008	"	3040
First "pay"	3012		
Second "pay"	3035		
Total depth			3049

Catharine Jones Well, No. 1.

McKim creek, Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Red rock	740	to	820
Slate	820	"	860
Red rock	860	"	980
Cow Run Sand	1000	"	1010
Salt Sand	1380	"	1500
Slate, soft	1500	"	1505
Slate, hard	1505	"	1600
Keener Sand (oil, 1782′)	1768	"	1792
Slate	1792	"	1804
Big Injun Sand (poor, no oil or gas)	1804	"	1890

Catharine Jones Well, No. 4.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Slate	16	to	116
Sand	116	"	141
Slate	141	"	191
Red rock	191	"	211
Slate	211	"	236
Lime	236	"	256
Red rock	256	"	306
Sand	306	"	356
Slate	356	"	406
Red rock	406	"	481
Lime	481	"	491
Slate	491	"	641
Sand	641	"	701
Slate	701	"	801
Sand	801	"	851
Red rock	851	"	876
Slate	876	"	896
Sand	896	"	916
Big slate cave	916	"	956
White slate	956	"	966
Slate	966	"	1016
Sand	1016	"	1216
Slate	1216	"	1251
Salt Sand	1251	"	1401
Slate	1401	"	1451
Sand	1451	"	1551
Slate	1551	"	1571
Sand	1571	"	1617
Sand	1617	"	1667
Sand	1667	"	1717

Slate	1717	"	1727
Big Lime	1727	"	1787
Keener Sand	1787	"	1797
Lime	1797	"	1810
Big Injun Sand (oil, 1828′)	1810	"	1858

Silas Henderson Well, No. 8.

Meade district. Authority, South Penn Oil Company.

	Feet.		Feet.
Sand	8	to	48
Lime and slate	48	"	548
Red rock	548	"	848
Cow Run Sand	848	"	852
Slate	857	"	872
Sand and slate	872	"	1220
Slate	1220	"	1412
Salt Sand	1412	"	1442
Slate	1442	"	1502
Cairo Sand (Maxton)	1502	"	1563
Big Lime	1563	"	1618
Keener Sand	1618	"	1636
Big Injun Sand (gas, 1655′; oil, 1665′)	1645	"	1704

Isaac Hawkins Well, No. 1.

Hebron region. Authority, Fisher Oil Company.

	Feet.
Top Sand (Big Injun)	1800
Gas	1800
Salt water	1865
Total depth	1887
Ten-inch casing	160
Eight-inch casing	1050
Six and five-eighths-inch casing	1746

Isaac Hawkins Well, No. 2.

Hebron region. Authority, Fisher Oil Company.

	Feet.		Feet.
Top of Sand (Big Injun)	2064		
Gas	2067		
Oil	2078	to	2085

Henthorne Well, No. 2.

Hebron region. Authority, Fisher Oil Company.

	Feet.		Feet.
Top of Sand (Big Injun)	1890		
Oil, 20 barrels per hour, at	1894	to	1900
Total depth			1912

Barker Well, No. 1.

Hebron region. Authority, Fisher Oil Company.

	Feet.		Feet.
Cow Run Sand	1010	to	1028
Top of Sand (Big Injun)	1882		
Top of "pay"	1926		
Bottom of pay and hole	1942		

J. S. Buck Well, No. 1.

Four miles east of Sistersville. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	600	to	900
Salt Sand (water, 1200′)	950	"	1250
Big Lime	1553	"	1629
Keener Sand (gas, 1628′ and 1640′)	1628	"	1644
"Good gas well."			

Tom Smith Well, No. 1.

Sistersville region. Authority, Crawford & Wilson.

	Feet.		Feet.
Cow Run Sand	1000	to	1018
Salt Sand	1400	"	1500
Big Lime	1800	"	1900
Big Injun Sand (strong gas, 1940′)	1903	"	1945
Ten-inch casing	200		
Eight-inch casing	1130		
Six and one-fourth-inch casing	1800		

Thistle Well, No. 5. (Gillespie.)

Sistersville field. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	1025		
Salt Sand	1090		
Big Lime	1415		
Big Injun Sand (oil, 1827′ and 1857′)	1777	to	1878

Dunfee Well, No. 14.

Upper part of Sistersville field. Authority, L. J. Brenneman.

	Feet.		Feet.
Coal (Washington)	150	to	154
Cow Run Sand	900	"	920
Salt Sand	1120	"	1380
Big Lime	1666	"	1726
"Break"	1726	"	1746
Big Injun Sand	1746	"	1848
Dry.			

J. Russell Well, No. 34.

Upper part of Sistersville field. Authority, L. J. Brenneman.

	Feet.		Feet.
Cow Run Sand	885	to	925
Salt Sand	1083	"	1283
Big Lime	1587	"	1657
"Break"	1677	"	1687
Big Injun Sand (oil, 1690′ and 1730′)	1687	"	1790

Anschutz Well, No. 1.

Sistersville region. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	880		
Salt Sand	1000		
Big Lime	1550	to	1641
"Break"	1641	"	1653
Big Injun Sand	1653	"	1728
First "pay"	1655	"	1667
Second "pay"	1677	"	1687

Keener Heirs' Well, No. 23.

Lower part of Sistersville field. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	1000	to	1050
Salt Sand	1150	"	1300
Big Lime	1700	"	1740
Keener Sand	1740	"	1770
"Break" (slate)	1770	"	1785
Big Injun Sand	1787	"	1865
First "pay"	1805	"	1815
Second "pay"	1835	"	1850

F. R. Wells Well, No. 41.

Lower part of Sistersville field. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	900		
Salt Sand	1000		
Big Lime	1650	(?)	
Break	1664	to	1676
Big Injun Sand (oil, 1681′ and 1721′)	1676	"	1750

Sarah A. Holmes Well, No. 8.

Lower part of Sistersville field. Authority, Carter Oil Company. About one mile from Ohio river.

	Feet.		Feet.
Cow Run Sand	1060	to	1080
Salt Sand	1200	"	1300

Big Lime	1760	"	1840
"Break" (slate)	1870	"	1880
Big Injun Sand (oil, 1890′ and 1920′)	1880	"	1970

John A. Davenport Well, No. 4.

Lower part of Sistersville field. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	810		
Salt Sand	1000		
Big Lime	1490		
Break	1575		
Big Injun Sand (oil, 1602′ and 1632′)	1597	to	1704

Russell Well, No. 1.

Sistersville region. Authority, Bettman, Watson & Company.

	Feet.
Sand (Big Injun) at	1755
Oil at 1759½ and	1776
Bottom of well	1802
Ten-inch casing	275
Seven and five-eighths-inch casing	920
Five and five-eighths-inch casing	1120

Early Well, No. 1.

Sistersville region. Authority, Bettman, Watson & Company.

	Feet.
Gas at	1235
Top of Sand (Big Injun)	1732
Second "pay"	1750
Finished drilling at	1759

Parr Well, No. 1.

Sistersville field. Authority, Fisher Oil Company.

	Feet.		Feet.
Keener Sand, top	1762	to	1780
Big Injun Sand	1806	"	1842

Morris Well, No. 2.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
Ten-inch casing	233
Eight and one-fourth-inch casing	890
Six and five-eighths-inch casing	1380
Keener Sand, top	1618
Bottom of Keener Sand	1640
Top Injun	1670
Water	1680
First pay	1700
Second pay	1715
Bottom	1727

Davenport Well, No. 1.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
First "pay" (Big Injun)	1566
Second "pay" (Big Injun)	1595
Bottom of well	1650

Davenport Well, No. 5.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
Eight and one-fourth-inch casing	748
Six and one-fourth-inch casing	1247
First "pay" (Big Injun)	1582
Bottom of well	1639

Wells Island Well, No. 9.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
Sand	1366
First oil	1376
Second oil	1396
Bottom of well	1432½
Ten-inch casing	42
Eight and one-fourth-inch casing	170
Six and one-fourth-inch casing	985

Wells Island Well, No. 10.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
Big Injun Sand	1365
First oil	1380
Bottom of well	1430
Ten-inch casing	50
Eight and one-fourth-inch casing	170
Six and one-fourth-inch casing	1002

Wells Island Well, No. 11.

Sistersville field. Authority, Fisher Oil Company.

	Feet.
Sand (Big Injun)	1366
First oil	1381
Bottom of well	1431
Ten-inch casing	50
Eight and one-fourth-inch casing	160
Six and one-fourth-inch casing	980

Low water in the Ohio river is about 25 to 30 feet below the general level of Wells Island, and the 10-inch casing in these records marks the depth to bed rock. The Pittsburg coal is

seldom reported in the wells drilled at Sistersville, but the Carter Oil Company reports it from its Mehrley well, No. 10, on the Ohio side of the river, opposite Sistersville, as follows:

Mehrley Well, No. 10.

	Feet.		Feet.
Unrecorded	175	to	175
Coal (Washington)	3	"	178
Unrecorded	407	"	585
Coal, Pittsburg	5	"	590
Unrecorded	430	"	1020
"Cow Run" Sand	50	"	1070
Unrecorded	55	"	1125
Sand, **Freeport**	150	"	1275
Unrecorded (contains **"Salt Sand"**)	365	"	1640
"Big Lime" (Mountain)	97	"	1737
"Big Injun" "break" ("Keener") Sand 15; Sand (oil 1st "pay," 1757, 63)	78	"	1815

This shows an interval of 1,147 feet between the *Pittsburg coal* and the *"Keener"* horizon of the *"Big Injun" Sand,* or 1,162 feet to what is known as the *"Injun"* proper in the Sistersville region, thus showing a thinning of 71 feet in this interval between the Pittsburg coal and the Big Injun Sand, in the eight miles from Falls Mills (B. F. Robinson Well, No. 2) northwest to Sistersville.

W. A. Beagle Well, No. 1.

Three and one-half miles east of Long Reach.

	Feet.		Feet.
Cave	600	to	760
Cow Run Sand	822	"	852
Salt Sand	1100	"	1230
Maxton Sand	1476	"	1493
Big Lime	1500	"	1565
Big Injun Sand	1565	"	1675

Dr. J. L. Thistle Well, No. 8.

About three miles east of Friendly. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	410	to	416
Cave	500		
Cow Run Sand	875	"	883
Salt Sand	970	"	1255
Maxton Sand	1425	"	1435

Big Lime	1523	"	1568
Keener Sand	1568	"	1620

Dr. J. L. Thistle Well No. 9.

	Feet.		Feet.
Pittsburg Coal	505	to	510
Cave	585		
Cow Run Sand	935		
Salt Sand	1065	"	1410
Maxton Sand	1520	"	1532
Big Lime	1600	"	1640
Keener Sand	1644	"	1698

Dr. J. L. Thistle Well, No. 10.

	Feet.		Feet.
Coal?	580		
Cow Run Sand	930	to	948
Salt Sand	1250	"	1365
Maxton Sand	1455	"	1540
Big Lime	1600	"	1673
Keener Sand	1673	"	1704

"In Thistle wells Nos. 1, 2, 3, 4, 5, 6 and 7 no coal noted; other strata about same."

Here we see in these records, the patchy nature of the Pittsburg coal over a large portion of Tyler county and the region to the southwest from it. For instance, in the first seven wells on Dr. J. L. Thistle's farm the coal was too thin to attract notice, while in Nos. 8 and 9 a fair thickness is reported at 1,134 to 1,152 feet above the top of the "Keener" Sand horizon of the "Big Injun," as against 1,147 feet for the same interval at Sistersville (Mehrley well, No. *10*). The sand called "Cow Run" in these records is not the First Cow Run of Ohio, but the Dunkard Sand of Greene county, Pa., while the true Second Cow Run Sand of Ohio belongs 150 to 200 feet below the Dunkard Sand or 400 to 500 feet below the First Cow Run Sand (Saltzburg).

A. H. Wells Well, No. 1.

Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Conductor			48
Cow Run Sand	745	to	751
Salt Sand	1000	"	1260
Big Lime	1515	"	1590

Keener Sand	1590	"	1645
Big Injun Sand	1645	"	1743
Total depth			1743

A. Heinzman Well, No. 1.

Lincoln district, between Pursley and Kidwell. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	470		
Cave	700		
Cow Run Sand	960	to	980
Salt Sand	1016	"	1516
Maxton Sand	1530	"	1550
Big Lime	1597	"	1647
Big Injun Sand	1669	"	1747

The Heinzman well is located about half-way between Middlebourne and Sistersville, and reveals an interval of 1,199 feet between the Pittsburg coal and the Big Injun Sand, as against 1,162 feet for this same interval in the Mehrley well, No. *10*, at Sistersville, and 1,267 feet in the Wm. Baker well, No. *1*, near Middlebourne, and 1,300 feet at the eastern line of Tyler, thus revealing a total decrease in this interval of 138 feet in passing from Alvy N. 60° W., 17½ miles to Sistersville, or say 8½ feet to the mile.

PLEASANTS COUNTY WELL RECORDS.

This county was the first in the State to produce very large flowing wells from the deeper sands (Berea), since the gusher wells at Eureka and Belmont were drilled in 1889 and 1890, while the deep sand oils were not developed in other portions (Mannington) of the State until 1891.

The earliest production of oil in Pleasants county was in the '60's soon after the discovery of oil at Burning Springs in Wirt county, since the great Eureka-Volcano-Burning Springs anticlinal along which the first, or "Shallow Sand," oil was developed passes directly across Pleasants, and thus brings the Cow Run, Big Injun and other sands near enough to the surface to be easily tapped by the primitive methods of the early oil operators. The production from the Berea Sand, although quite large at one time in 1890, did not hold up long, since the pool was

small, and did not extend but a short distance away from the region of the rock disturbance caused by the anticlinal uplift referred to above. The "shallow" sands, however, principally the two Cow Run Sands, have been found productive over quite a large area of the county, while the Maxton, "Keener," Big Injun proper, and possibly some members of the Salt Sand have all produced more or less oil and gas within the county's limits, so that, although not large in area, Pleasants has produced a large quantity of oil, and will still continue so to do for many years in the future.

The following record is from a well near the northeastern border of the county, close to the Tyler county line. It was received from the late Prof. John F. Carll, and reads as follows:

Jim Wells Well No. 1.

Near Bens Run Station, Union district.

	Feet.		Feet.
Water at			60
Coal (Sewickley) at			120
Cow Run Sand	702	to	782
Slate	782	"	792
Sandstone	792	"	800
Slate	800	"	815
Lime	815	"	900
Slate	900	"	995
Sandstone, white	995	"	1005
Slate, black (gas)	1005	"	1050
Slate, white	1050	"	1068
Slate, black	1068	"	1150
Slate and sandstone	1150	"	1160
Sandstone, clear, oil, black	1160	"	1186
Slate and shells	1186	"	1243
Sand (Maxton) good, (oil, 1243′)	1243	"	1264
Slate	1264	"	1286
Sandstone and lime (Big)	1286	"	1347
Sand, Keener	1347	"	1412
"Break" (slate)	1412	"	1436
Sandstone, close and hard 14′; Slate, break 10′; (?) 10′; Sandstone, white 55′ — Big Injun	1436	"	1525
Slate, white, to bottom	1525	"	1605

The coal bed noted in this record at 120 feet is most probably a representative of the Sewickley bed, since it comes 1,227 feet above the Keener Sand, 80 feet more than that shown for this interval at Sistersville, 14 miles to the northeast, hence the horizon of the Pittsburg coal would come at about 200 feet in this well. It is needless to say that the stratum called "Cow Run" Sand by the driller is not either the first or second of these oil horizons since the first Cow Run Sand comes about 300 feet below the Pittsburg coal, while the second Cow Run Sand, on Cow run, in Ohio, comes 400 feet lower, or about 700 feet below the Pittsburg coal, and thus makes it most probably in the Lower Freeport sandstone horizon of the Allegheny formation.

In Bulletin No. 1 of the Geological Survey of Ohio, published in 1903 by Prof. J. A. Bownocker, a record of Centennial well, No. 6, of the Exchange Oil Company, by Mr. George Lehmer, is given on pages 168 and 169, which will prove useful in showing the relationships of both the First and Second Cow Run Sands to other well-known beds at the original locality on Cow run, Washington county, Ohio.

Centennial Well, No. 6. Cow run.

	Thickness of stratum, Feet.		Total depth, Feet.
Conductor	11	to	11
Pittsburg (Pomeroy) Coal	1	"	12
Calcareous shale	9	"	21
Lime	10	"	31
Red soapstone	5	"	36
Red shale	8	"	44
White shale	42	"	86
Lime	10	"	96
Mixed shale	5	"	101
Shale and water	19	"	120
Red shale	10	"	130
Sand	5	"	135
White shale	20	"	155
Red shale	22	"	177
White shale	23	"	200
Sand	3	"	203
Red rock	32	"	235

Sand	11	"	246
White slate	40	"	286
Sand	4	"	290
Sand	4	"	294
Coal, smut rock	1	"	295
White slate	4	"	299
Lime	8	"	307
Gray shale	2	"	309
Lime (5)	9	"	314
Fire clay	4	"	318
Lime	7	"	325
First Cow Run Sand	47	"	372
Red rock	23	"	395
White shale	46	"	441
Dark shale	50	"	491
Sand	10	"	501
White shale	14	"	515
Pale red shale, very hard	64	"	579
Lime	5	"	584
Sand	10	"	594
Black shale	16	"	610
White shale	30	"	640
Sand	10	"	650
Coal	1	"	651
Sand	39	"	690
Dark shale	5	"	695
Sand, gas	7	"	702
White shale	11	"	713
Coal, smut rock	1	"	714
Fire clay	20	"	734
Sand	2	"	736
Sandy shale	6	"	742
Black shale	4	"	746
Slate, black	30	"	776
Second Cow Run Sand	64	"	840
Black slate	3	"	843
Black slate	97	"	940
Sand	83	"	1023
Dark shale	57	"	1080
Sand	12	"	1092
Black shale	53	"	1145
Salt Sand (no water)	9	"	1154
Light shale	6	"	1160
Black shale	23	"	1183
Big Injun Sand	2	"	1185
Dark shale	39	"	1224
Sand	2	"	1226
Dark shale	7	"	1233

Sand	7	"	1240
Sandy shale, hard	22	"	1262
Dark shale, hard	63	"	1325
Dark shale, softer	20	"	1345
Dark shale	20	"	1365
Dark shale, hard	10	"	1375

This record shows that the true First Cow Run Sand comes 313 feet below the Pittsburg coal, and its bottom extends to 360 feet below that well-known horizon, thus making it the equivalent of the Saltsburg sandstone of the Conemaugh series, entirely above the Mahoning sandstones, with which it has so frequently been confused, since the Dunkard Sand, which is so frequently termed "Cow Run" by the drillers in West Virginia, is a member of the Mahoning series, and its top underlies the Pittsburg coal about 425 feet at the original locality, on Dunkard creek, Greene county, Pa., its thickness being 50 to 60 feet. The Second Cow Run Sand lies 406 feet below the First Cow Run, and is therefore either the Lower Freeport sandstone, or else the top member (Homewood) of the Pottsville formation.

Luther Brown Well, No. 1.

Two miles east of south from Bens run, Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Salt Sand	1220	to	1340
Big Lime	1700	"	1766
Keener Sand	1766	"	1791
Slate	1791	"	1811
Big Injun Sand, hard (oil, 1812-16')	1811	"	1905
Squaw Sand	1912	"	1935
Total depth	1940		

"Three-barrel well."

Mercer-Pool Well, No. 1.

Near Lytton Postoffice, Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand (coal, 790')	784	to	794
Salt Sand	1080	"	1190
Maxton Sand	1498	"	1516
Big Lime	1575	"	1635
Keener Sand (gas, 1640')	1635	"	1670
Big Injun Sand, very hard and broken	1690	"	1770

J. L. Pool Well, No. 2.

Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	876	to	905
Salt Sand	1180	"	1255
Maxton Sand (oil and gas show, 1624')	1588	"	1667
Big Lime	1667	"	1678
Keener Sand (gas, 1710')	1698	"	1755
Big Injun Sand (show oil, 1804')	1774	"	1866
Total depth			1871

M. J. Beagle Well, No. 1.

Two miles south of east of Bens run, Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Salt Sand	1150	"	1450
Maxton Sand	1600	"	1635
Show oil	1696		
Big Lime	1715	"	1730
Keener Sand	1730	"	1765
Big Injun Sand, little oil and gas at 1779'	1779	"	1840
Squaw Sand	1840	"	1900

Hubbard (purchase) Well, No. 16.

Three miles east of Bens run. Authority, Carter Oil Company.

	Feet.		Feet.
Cave (bad)	685	to	885
Cow Run Sand (oil and gas at 901')	895	"	919

"About twenty-barrel well."

C. B. Barker Well, No. 1.

On Middle Island creek. Owners, Philadelphia Company. Authority, Prof. John F. Carll.

	Feet.		Feet.
Clay	10	to	10
Sandstone	20	"	30
Gravel	20	"	50
Sandstone and lime	30	"	80
Red sandstone	15	"	95
Lime, white, hard (water)	20	"	115
Red lime	10	"	125
Lime, white, hard	5	"	130
Slate, white and soft	10	"	140
Sandstone, dark and hard	15	"	155
Slate, white, soft	5	"	160
Lime, white, soft	4	"	164
Coal (Pittsburg)	1	"	165
Slate, white and soft	10	"	175

Red shale	10	"	185
Slate, white	20	"	205
Sandstone, dark, close	40	"	245
Red shale, soft	20	"	265
Lime	10	"	275
Red shale	10	"	285
Lome, white	5	"	290
Red shale	70	"	360
Slate, white	20	"	380
Red shale	20	"	400
Lime, white	20	"	420
Red cave	45	"	465
Unrecorded	25	"	490
Lime, white	20	"	510
Coal (Bakerstown)	5	"	515
Slate, white	30	"	545
Lime, white	15	"	560
Slate, white, caves	40	"	600
Sandstone, dark, close, (Dunkard)	20	"	620
Sandstone and lime, hard and soft	10	"	630
Slate, dark and soft	40	"	670
Slate, white	30	"	700
Slate, white, soft	80	"	780
Sandstone, white, close, (Second Cow Run)	70	"	850
Slate, black, soft	60	"	910
Sandstone, white (Salt Sand)	90	"	1000
Slate, black, soft	80	"	1080
Sandstone, white, (Salt Sand)	45	"	1125
Slate, black, soft	25	"	1150
Sandstone white 10′ / Slate 25′ / Sandstone, white and soft 20′ } Maxton	55	"	1205
Slate, black and soft	65	"	1270
Lime, white and hard, (Big Lime)	70	"	1340
Sandstone, white, (little gas) (Keener)	5	"	1345
Lime, dark and hard	10	"	1355
Lime, white	20	"	1375
Sandstone, hard and soft	30	"	1405
Slate, white and soft	16	"	1421
Sandstone, white, Big Injun, (oil and water at 1440′)	179	"	1600
Slate and shell, white	50	"	1650
Sandstone and slate	50	"	1700
Slate, white	175	"	1875
Slate, black and soft,	57	"	1932

The *one foot* of coal struck at 164 feet appears to belong at the horizon of the Pittsburg bed, since it comes 1,175 feet above

the top of the Keener Sand, and 1,257 feet above the top of the main body of the Big Injun Sand.

Thomas H. Whaley Well, No. 1.

Near Maxwell Postoffice, Eastern Pleasants. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1210	to	1216
Salt Sand	1560	"	1775
Maxton Sand	1790	"	1820
Big Lime	1850	"	1929
Keener Sand	1929	"	1941
Break (slate)	1941		
Big Injun Sand (gas 1965′)	1941	"	2020

W. J. Shingleton Well, No. 1.

One mile east of Maxwell Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	315	"	715
Cow Run Sand (poor)	715	"	731
Salt Sand	1100	"	1395
Maxton Sand, hard	1487	"	1527
Cave	None		
Big Lime	1547	"	1577
Keener Sand (oil and gas)	1577	"	1632
Big Injun Sand (broken), (black scum at 1663′)	1631	"	1769
Total depth	1779		
"Five to ten barrel well."			

Shingleton Well, No. 11.

Near Hebron. Authority, Bettman & Watson Company.

	Feet.		Feet.
Top of cave	900		
Cow Run Sand	1080	"	1090
Salt Sand	1300	"	1500
Big Lime, top	1870	"	1946
Break (Slate)	1946	"	1950
Keener Sand	1950		
Hard, fine, dark sand (salt water at 1970′)	1965		
Big Injun Sand, top	1998	"	2025
Show of oil and gas	2002		
Salt water	2007		
Slate	2007	"	2012

Ada Weekley Well, No. 2.

Lafayette district. Authority, South Penn Oil Company.

	Feet.		Feet.
Salt Sand (gas 1930′)	1680	to	1948
Maxton Sand	1948	"	1969
Big Lime	1969	"	2036
Big Injun Sand	2036	"	2181

A. W. Gorrell Well, No. 2.

Lafayette district. Authority, South Penn Oil Company.

	Feet.		Feet.
Salt Sand	1166	to	1200
Maxton Sand	1673	"	1703
Big Lime	1721	"	1762
Keener Sand	1792	"	1810
"Break" (slate)	1810	"	1816
Big Injun Sand	1816	"	1905
Berea (shells)	2273	"	2288
Red rock	2434	"	2446
Gordon Sand (shells)	2553	"	2568
Fifth Sand	2656	"	2668
Total depth	2750		

This is a very interesting record, since in it are found some traces of the Venango Oil Sand Group, notably the *red* beds at 2,434 feet which belong just under the "Fifty-foot" Sand; also, the Gordon and Fifth Sands appear to be indicated by "Shells," or hard, fine, sandy beds, at 2,553 and 2,656 respectively. If we put the interval of the Pittsburg coal above the Keener Sand at say 1,200 feet, the horizon of that coal would be found at about 600 feet in the above record, or 1,673 feet above the "Berea" Sand, 1,834 feet above the *red beds,* 1,953 feet above the Gordon Sand, and 2,056 feet above the Fifth Sand, all of which measurements agree with the westward thinning of the beds.

On Broad run, about two and a half miles east from St. Marys, many wells have been found in what the drillers term the "Cow Run" Sand, at depths varying with the surface from 600 feet up to 1,000 or more. The wells are generally cased with $8\frac{1}{4}$-inch casing to a depth of 460 to 475 feet above the Sand, and then with $6\frac{1}{4}$-inch casing down to the top of the Cow Run Sand, so that the horizon is doubtless identical with that of the Dunkard, although no detailed records are obtainable for study, the casing records being the only data available which would throw any light upon the matter.

Several wells have been drilled on the land of Eliza DeLong by Bartlett & Standcliffe, and their records reveal the following data:

Eliza DeLong Well, No. 1.

	Feet.		Feet.
Cow Run Sand (oil 617-630′)	610	to	631
Total depth	649		

Eliza DeLong Well, No. 2.

	Feet.		Feet.
Cow Run Sand	762	to	783
Total depth			795
Eight and one-fourth inch casing	335		
Six and one-fourth inch casing	735		

Eliza DeLong Well, No. 3.

	Feet.		Feet.
Cow Run Sand	800	to	815
Total depth			823
Eight and one-fourth inch casing	325		
Six ond one-fourth-inch casing	800		

Eliza DeLong Well, No. 4.

	Feet.		Feet.
Cow Run Sand	926	to	941
Total depth			945
Eight and one-fourth-inch casing	455		
Six and one-fourth inch casing	915		

Eliza DeLong Well, No. 5.

	Feet.		Feet.
Cow Run Sand	944	to	962
Total depth			996
Eight and one-fourth inch casing	475		
Six and one-fourth inch casing	935		

Another record of a Cow Run Sand well is given by Bettman, Watson & Company, from the Bucy farm, near Belmont, as follows:

Bucy Well, No. 4.

	Feet.		Feet.
Cow Run Sand, top	545		
Show of oil	548	to	550
Slate, break	560	"	565
Sand, coarse and soft	565	"	583
Bottom of Cow Run Sand			583
Bottom of well			587
Eight and one-fourth-inch casing	271		
Six and five-eighths-inch casing	515		

Sharp Well, No. 1.

One mile and a half east from Waverly. Authority, F. D. T. Beckley, Superintendent of the Calf Creek Oil Company.

	Feet.		Feet.
Unrecorded	0	to	618
Cow Run Sand	12	"	630
Unrecorded	510	"	1140
Salt Sand (water 1180-1220′)	100	"	1240
Slate	40	"	1280
Sand (Maxton)	20	"	1300
Big Lime	40	"	1340
Mixed shale, merging into black slate	73	"	1413
Big Injun Sand (gas 1413′, oil 1423′ and 1428′)	25	"	1438

P. Triplett Well, No. 1.

Grant district. Authority, Union Oil Company.

	Feet.
Big Injun Sand	1461
Show of oil	1480
Water	1481
Eight and one-fourth inch casing	788
Six and one-fourth inch casing	1325

A. Ruckman Well, No. 1.

Grant district. Authority, Union Oil Company.

	Feet.
Eight and one-fourth inch casing	600
Six and one-fourth-inch casing	1530
Gas	1858
Oil	1858
Bottom	2000

J. R. Bill Wells.

Jefferson district. Authority, South Penn Oil Company.

	No. 1. Feet.	No. 2 Feet.	No. 3. Feet.
Cow Run Sand	560-576	621-636	622-623

S. W. Pratt Well, No. 3.

Jefferson district. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	650	to	667
Salt Sand (oil show)	1065	"	1080
Maxton Sand (gas at 1231′)	1330	"	1345
Keener Sand (oil and gas 1460′)	1459	"	1465
Big Injun Sand to bottom	1465	"	1470

The following data concerning the Cow Run Sand in several

portions of Pleasants county are from C. D. Bole, M. L. Zahneizer and others.

Copenhaver Well.

Iron Bridge, Middle Island creek.

	Feet.		Feet.
Cow Run Sand	587	to	614

Bell Farm Well, No. 27.

Bens run.

	Feet.		Feet.
Cow Run Sand	905	to	947

Wagner Well, No. 3.

On Sugar creek, three to four miles from mouth.

	Feet.		Feet.
Cow Run Sand	651	to	686

Jones Farm Well.

Right fork of French creek.

	Feet.		Feet.
Cow Run Sand	692	to	708

G. C. Roby Well, No. 9.

Six miles east of St. Marys.

	Feet.		Feet.
Cow Run Sand	806	to	826

J. H. & H. P. Lock Farm.

Middle Island creek, seven miles from mouth.

	Feet.		Feet.
Cow Run Sand	509	to	530

McCuen Well.

Three miles east of Raven Rock.

	Feet.
Black shale, 5 to 10 feet thick	750
Top Cow Run Sand	814

Dotson Farm Well, No. 1.

On Long run of French creek, two miles south of St. Marys.

	Feet.
Black shale at	403
Cow Run Sand	468

Dotson Farm Well, No. 2.

	Feet.
Cow Run Sand	480

"Black shale with coal found all through Washington district, 400 feet below the river."

As already stated, the great Burning Springs-Volcano anticlinal passes through Pleasants county, crossing the Ohio river near Eureka, where it brings up the Berea Sand to only about 1,100 to 1,200 feet below river level, on its crest, the Ames limestone getting above water level. The Berea Grit proved quite productive along this arch, but the pool was soon exhausted.

A well drilled on Brothers Island gave the following record, according to Mr. W. C. Brockunier, of Wheeling, its owner:

Brothers Island Well, No. 1.

	Feet.		Feet.
Drive pipe (through clay and gravel)....	80	to	80
Unrecorded	120	"	200
Sand, heavy oil, (1st Cow Run)..........			
Unrecorded	215	"	415
Sand, oil show with water..............	25	"	440
Unrecorded	100	"	540
Second Cow Run Sand.................	60	"	600
Unrecorded	40	"	640
Salt Water Sand (**"Salt Sand"** and **"Big Injun"**)	330	"	970
Shales, with 40 feet of black slate at bottom	378	"	1348
Berea Grit, oil.			

This shows about 40 feet of filling in the river channel here, below the bed of the same. The sand at 200 feet is supposed to be the *First Cow Run*, and that at 540 feet the *Second* one.

Another well, on the Cook farm up French creek, one mile back from the river, gives more detail, and starts on the hill. It is as follows, according to Mr. Brockunier:

Cook Farm Well, on French Creek, Near Eureka.

	Feet.		Feet.
Unrecorded (cased 7⅝-inch at 305 feet.).	390	to	390
First Cow Run Sand	50	"	440
Dark Shales...........................	160	"	600
Sand	48	"	648
Shales	52	"	700
Sand	50	"	750
Shale, black..........................	95	"	845
"Salt Sand" (**"Salt sand** proper and **"Big Injun,"** oil 945 ft., oil and gas 1090 ft., with big pebbles, salt water at 1125 ft.).......................	375	"	1220

Slates and shales, oil show at 1415......	347	"	1567
Berea Sand..........................	4	"	1571
Unrecorded to bottom..................	31	"	1602

The *Berea Sand* varied from 0 to 35 feet in thickness in this region, and some of the wells flowed 20 to 30 barrels an hour. The field was of limited area, owing to the rapid dip on each side of the great arch, and the available territory was soon drilled over.

The sand at 390 feet is called the *First Cow Run* by the drillers, and is the same as that struck at 200 feet in the Brothers Island well, while that at 700 feet is supposed to be the *Second Cow Run Sand.*

DODDRIDGE COUNTY WELL RECORDS.

Doddridge county lies southeast from Pleasants and Tyler, its northwestern boundary abutting against the latter. It therefore occupies a central position in the great Appalachian trough, and hence has proven very prolific in both gas and oil through the whole column of oil sands from the First Cow Run down to the Fifth, or McDonald Sand, 2,300 feet below the Pittsburg coal.

The oil history of Doddridge county began with the drilling of a well on the Sullivan Heirs' farm by the South Penn Oil Company, early in 1892, which secured a fairly good well in the Big Injun Sand at a depth of 1910 feet. The success of this first test well in Doddridge soon led to the drilling of others, so that its oil and gas production increased rapidly thereafter, and has now spread to every portion of the county, so that while many dry holes have been drilled, it is possible to find either oil or gas in valuable quantities in every portion of its area.

The following well records from the different regions will illustrate the underground succession in Doddridge:

Samuel Collins Well, No. 3.

One mile west of Centerpoint, McClellan district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Native coal (Uniontown?)..............	168	to	171
Pittsburg Coal	448	"	454
Dunkard Sand..........................	1020	"	1135

Gas Sand	1150	"	1180
Salt Sand	1320	"	1470
Little Lime	1710	"	1730
Pencil cave	1730	"	1745
Big Lime	1745	"	1804
Big Injun Sand	1804	"	1950
Gas, 1890′-1895′; gas and oil	1902		

It is possible that the coal identified by the drillers in the Centerpoint region as the Pittsburg may be the Sewickley, or Mapletown, and in that event the "Native" coal of the record would be the Waynesburg, instead of the Uniontown.

A. Glasspell Well, No. 1.

McClellan district. Authority, Carnegie Natural Gas Company.

	Feet.		Feet.
Unrecorded	210	to	210
Native coal (Washington)			210
Unrecorded	500	"	710
Pittsburg Coal			710
Unrecorded	410	"	1120
Little Dunkard Sand	35	"	1155
Unrecorded	45	"	1200
Big Dunkard Sand	35	"	1235
Unrecorded	165	"	1400
"Gas" Sand	80	"	1480
Unrecorded	220	"	1700
Salt Sand	40	"	1740
Unrecorded	160	"	1900
Little Lime	10	"	1910
Unrecorded	15	"	1925
Big Lime	75	"	2000
Big Injun Sand	100	"	2100
Unrecorded	375	"	2475
"Thirty-Foot Sand (Berea)	10	"	2485
Unrecorded	224	"	2709
Sand	15	"	2724
Unrecorded	24	"	2748
Gordon Stray	25	"	2773
Gordon Sand (top)			2773

"First Gas at 2771′; Second gas at 2778′; Third gas at 2800′—so strong that drilling had to be suspended."

H. J. Shahan Well, No. 1.

Near Cascara, three to four miles south from Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	650	"	660

Cave	790	"	990
Cow Run Sand	990	"	1000
Salt Sand	1400	"	1430
Maxton Sand?	1720	"	1755
Big Lime	1900	"	1950
Big Injun Sand (gas 1950′ & 1960′; oil 2063′)	1950	"	2063
Gantz Sand	2572	"	2592
Gordon Stray	2644	"	2679
Gordon Sand (gas, 2730-45′)	2730	"	2750
Total depth			2760

The sand identified by the driller as the Maxton in the above record is probably only the bottom portion of the Pottsville or Salt Sand.

E. Stringer Boggess Well, No. 1.

One mile west from Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg? Coal (Sewickley)	455	to	460
Cow Run Sand	1025	"	1040
Salt Sand	1100	"	1300
Big Lime	1745	"	1820
Big Injun Sand (gas 1820′)	1820	"	1920
Gordon Sand (shells)	2600		
Total depth			2800

George Frum Well, No. 1 (T. G. Frum).

Near Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	964	to	975
Cave	1200	"	1295
Cow Run Sand	1397	"	1472
Salt Sand	1841	"	1960
Big Lime	2197	"	2247
Big Injun Sand	2247	"	2338
Berea Grit	2718	"	2736
Sand	2940	"	2960
Gordon Stray	3009	"	3046
Gordon Sand (oil 3076′)	3063	"	3080
Total depth (no 5th Sand)			3295

Eliza J. Webb Heirs' Well, No. 1 (John J. Webb).

Near Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	725	to	737
Cave	1000	"	1280
Cow Run Sand	1280	"	1310
Salt Sand	1500	"	1675

Maxton Sand	1885	"	1894
Big Lime	1970	"	2035
Big Injun Sand	2035	"	2128
Gordon Stray	2701	"	2723
Gordon Sand	2752	"	2792
Total depth			2823

Eliza J. Webb, No. 2.

	Feet.		Feet.
Pittsburg Coal	970	to	980
Cave	1290	"	1490
Cow Run Sand	1500	"	1550
Salt Sand	1820	"	1896
Maxton Sand	2050	"	2090
Big Lime	2208	"	2298
Big Injun Sand	2310	"	2380
Stray Sand (oil, 3025′)	2990	"	3030
Gordon Sand	3047	"	3069
Total depth			3075

Wm. A. Chess Well, No. 2.

One-fourth mile west from Doddridge-Harrison county line and four miles south of Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	1017	to	1022
Cow Run Sand	1533	"	1605
Salt Sand	1885	"	2010
Maxton Sand	2140	"	2165
Big Lime	2290	"	2340
Big Injun Sand	2340	"	2452
Stray Sand (oil, 3082′)	3080	"	3094
Gordon Sand	3097	"	3107
Total depth			3139

I. N. Riffee Well, No. 2.

Two and one-fourth miles south 10° east from Sedalia. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	840	to	847
Cave	975	"	1355
Cow Run Sand	1357	"	1362
Salt Sand	1680	"	1750
Big Lime	2080	"	2143
Big Injun Sand	2143	"	2248
Stray Sand	2838	"	2850
Gordon Sand (gas, 2858′; oil, 2862′)	2855	"	2883
Fifth Sand	3026	"	3029

In the I. N. Riffee wells, Nos. 1, 3 and 4, the Pittsburg coal is reported as 10 feet, 6 feet and 10 feet thick, at depths of 775 feet, 1,070 feet and 1,106 feet respectively.

Silas Langfit Well, No. 3.

McClellan district. Authority, South Penn Oil Company.

	Feet.
Pittsburg Coal	695
Big Injun Sand	2028
First "pay" (no good)	2105
Second "pay" (good)	2135
Total depth	2158

Jacob Underwood Well, No. 9.

Near Tyler county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	925		
Dunkard Sand (oil)	1396		
Big Injun Sand (gas, 2266′; oil, black, 2294′)	2258	to	2399
"Oil show"	2365		

Jamison Hutson Well, No. 1.

McClellan district. Authority, South Penn Oil Company.

Pittsburg Coal	775	to	781
Dunkard Sand	1290	"	1320
Salt Sand	1700	"	1790
Pencil cave	1985	"	1990
Big Lime	1990	"	2080
Big Injun Sand	2080	"	2200
Fifty-foot Sand	2710	"	2750
Sand (Stray)	2793	"	2823
Slate	2823	"	2858
Sand (Gordon)	2858	"	2872
Slate and shells	2872	"	3206

Viola Hare Well, No. 1.

McClellan district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	765		
Little Dunkard Sand	1189	to	1220
Big Dunkard Sand	1310	"	1350
Salt Sand	1660	"	1760
Little Lime	1934	"	1964
Big Lime	1990	"	2062
Big Injun Sand	2062	"	2190
Fifty-foot Sand	2640	"	2663
"Bowlder" Sand	2706	"	2740

Stray Sand	2786	"	2828
Gordon Sand	2850	"	2860
Total depth			2901

A. F. M. Lyons Well, No. 1.

McClellan district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	685		
Big Dunkard Sand	1200	to	1250
Gas Sand	1300	"	1320
Salt Sand	1550	"	1610
Sand	1780	"	1835
Maxton Sand	1860	"	1875
Big Lime	1960	"	2000
Big Injun Sand	2000	"	2100
Stray (gas, 2710′)	2697	"	2733
Gordon Sand (oil, 2763′)	2763	"	2783
Total depth			2791

C. V. Lyons Well, No. 1.

McClellan district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	807	to	815
Dunkard Sand	1345	"	1400
Salt Sand	1700	"	1800
Big Lime	2050	"	2100
Big Injun Sand	2110	"	2210
Stray Sand (gas, 2854′; oil, 2860′)	2834	"	2866
Gordon Sand	2887	"	2908
Total depth			2910

S. Stark Well, No. 6.

McClellan district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	980		
Little Dunkard Sand	1425	to	1460
Big Dunkard Sand	1535	"	1590
Gas Sand (Second Cow Run)	1815	"	1890
Salt Sand	1975	"	2010
Maxton Sand	2060	"	2100
Little Lime	2170	"	2220
Big Lime	2230	"	2285
Big Injun Sand	2285	"	2400
Fifty-foot Sand	2850	"	2875
Stray Sand (gas, 2998′ and 3014′)	2996	"	3043
Gordon Sand (oil, 3072′)	3067	"	3087

E. E. Smith Well, No. 1.

McClellan district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	725	to	735
Dunkard Sand	1235	"	1335
Salt Sand	1650	"	1700
Big Lime	1960	"	2035
Big Injun Sand	2035	"	2135
Fifty-foot Sand	2600	"	2605
Sand ("Thirty-foot")	2680	"	2715
Sand (Stray) oil, 2774′	2737	"	2781
Slate	2781	"	2802
Sand (Gordon) oil, 2806′	2802	"	2806

F. J. Bartlett Well, No. 1.

McClellan district, near Cascara. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1022		
Little Dunkard Sand	1430		
Big Dunkard Sand	1550	to	1615
Salt Sand	2005	"	2045
Maxton Sand	2081	"	2150
Big Lime	2250	"	2320
Big Injun Sand	2340	"	2440
Fifty-foot Sand	2875	"	2900
"Bowlder" Sand	2975	"	3000
Stray Sand (oil and gas 3052′)	3017	"	3062
Gordon Sand	3072	"	3086

Joseph Gaskins Well, No. 1.

One mile and a half southwest of Alpha Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	699	to	702
Cave (bad)	900	"	1200
Cow Run Sand	1224	"	1236
Salt Sand	1610	"	1660
Salt Sand	1698	"	1754
Maxton Sand	1765	"	1860
Big Lime	1978	"	2040
Big Injun Sand (gas, 2075′)	2040	"	2140
Berea (poor)	2372	"	2440
Gordon Stray	2752	"	2758
Gordon Sand (gas, 2769′)	2765	"	2771
Total depth			2795
(Gas well.)			

M. V. Underwood Well, No. 1

One mile west of Alpha Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	750	to	755
Cave	1025	"	1300
Cow Run Sand	1300	"	1388
Salt Sand	1490	"	1510
Salt Sand	1580	"	1650
Maxton Sand (gas, 1869′; oil, 1905′)	1861	"	1956
Cave	2025	"	2035
Big Lime	2035	"	2130
Big Injun Sand	2130	"	2230
Sand, poor	2420	"	2440
Berea, poor	2480	"	2510
Gordon Stray, poor	2813	"	2818
Gordon Sand (gas, 2835′)	2833	"	2843
Total depth			2843

O. W. O. Hardman Well, No. 1.

Grant district, near Tyler line. Authority, E. H. Jennings & Brothers.

	Feet.		Feet.
First Coal	54		
Lime	336		
Coal	525		
Coal (Sewickley)	558		
"Hurry Up" Sand 90 feet	935		
Top of Dunkard Sand	1115		
Gas Sand, 30 feet	1305		
Salt Sand (water, 1559′)	1500	to	1560
Pencil cave, 8 feet	1855		
Top of Big Injun Sand (water, 2075′)	1960		
Top Gordon Sand (gas, 2690′)	2670		
Bottom of Gordon Sand	2698		
Fourth Sand	2738		
Shells and slate to bottom	2826		

O. W. O. Hardman Well, No. 14.

Grant district, near Tyler county line. Authority, E. H. Jennings & Brothers.

	Feet.
Pittsburg Coal	830
Top of Big Injun Sand	2120
First "pay"	2230
Fair Sand	2240
Bottom of hole	2257

M. J. Francis Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	900	to	908
Salt Sand (water, 1770′)	1740	"	1830
Big Lime	2160	"	2226
Big Injun Sand (gas, 2235′)	2226	"	2335
Sand (Stray)	2972	"	2987
Slate	2987	"	3013
Sand, Gordon (oil, 3015 to 3020′)	3013	"	3022

J. M. Pratt Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
"Bluff" Sand	380	to	420
Pittsburg? Coal	784	"	790
Dunkard Sand	1305	"	1325
Salt Sand	1530	"	1724
Pencil cave	2064	"	2070
Big Lime	2070	"	2140
Big Injun Sand	2160	"	2225
Fifty-foot Sand	2715	"	2750
Stray Sand	2819	"	2834
Slate	2834	"	2858
Gordon Sand	2858	"	2870
Slate to bottom	2870	"	2872

E. J. Polan Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
"Bluff" Sand (Waynesburg)	750	to	800
Pittsburg Coal	1090	"	1097
Dunkard Sand	1610	"	1622
Salt Sand	1880	"	2030
Pencil cave	2362	"	2370
Big Lime	2370	"	2415
Big Injun Sand	2415	"	2550
Fifty-foot Sand	3020	"	3050
Stray Sand (strong gas, 3171′)	3170	"	3185
Slate (oil show, 3176′)	3185	"	3205
Gordon Sand (oil, 3212′)	3205	"	3218
Total depth			3218

P. Shaughnessey Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	645	to	650
Dunkard Sand	1175	"	1200
Salt Sand	1475	"	1570

Pencil cave	1920	"	1925
Big Lime	1925	"	2000
Black slate	2000	"	2010
Big Injun Sand	2010	"	2095
Fifty-foot Sand	2545	"	2585
Gordon Sand (gas, 2721′)	2721	"	2725

Milton Davis Well, No. 5.

Grant district, two miles northwest of Salem. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1015		
Sand	1865	to	1915
Sand (Maxton)	2156	"	2196
Big Lime	2270	"	2350
Sand (Big Injun)	2352	"	2463
Stray Sand (oil and gas, 3090′)	3084	"	3101
Slate	3101	"	3123
Gordon Sand (gas, 3133′)	3123	"	3134
Slate to bottom	3134	"	3135

Nellie Bee Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	995	to	1001
Little Dunkard Sand	1525	"	1555
Big Dunkard Sand	1630	"	1680
Salt Sand	1960	"	1990
Little Lime	2170	"	2200
Pencil cave	2200	"	2206
Big Lime	2206	"	2291
Big Injun Sand	2291	"	2386
Thirty-foot Sand	2970		
Stray Sand (gas, 3072′; show oil, 3082′)	3071	"	3089
Slate	3089	"	3111
Gordon Sand (oil, 3114′)	3111	"	3122

M. J. Carr Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	380		
Dunkard Sand	880	to	925
Salt Sand	1430	"	1490
Big Lime	1660	"	1730
Big Injun Sand	1730	"	1860
Fifty-foot Sand	2280	"	2300
Sand (Stray)	2429	"	2436
Slate	2436	"	2464
Lime	2464	"	2474

Lime and shells	2474	"	2520
Sand (Fourth)	2520	"	2525
Lime	2525	"	2530
Slate	2530	"	2535
Lime and shells	2535	"	2590
Slate	2590	"	2610
Lime and shells	2610	"	2660
Slate	2660	"	2702
Lime	2702	"	2730
Slate to bottom	2730	"	2735

A. A. Davis Well, No. 1.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	742	to	750
Dunkard Sand	1262	"	1290
Gas Sand (Second Cow Run)	1400	"	1435
Salt Sand	1640	"	1720
Pencil cave	1980	"	1985
Big Lime	1985	"	2075
Big Injun Sand	2075	"	2185
Fifty-foot Sand	2690	"	2730
Sand	2737	"	2767
Sand shell	2767	"	2811
Sand (Stray) gas, 2811′	2811	"	2830
Slate	2830	"	2849
Sand, Gordon (oil, 2851′)	2849	"	2864
Slate to bottom	2864	"	2881

A. A. Davis Well, No. 2.

Grant district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	882	to	890
Dunkard Sand	1317	"	1350
Salt Sand	1733	"	1790
Big Lime	2145	"	2215
Big Injun Sand	2215	"	2337
Fifty-foot Sand	2802	"	2835
Stray Sand (gas, 2961′; oil, 2962′)	2960	"	2979
Gordon Sand to bottom	2997	"	3007

Thos. Devaney Well, No. 1.

One mile east of Long run, Grant district, Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	903	to	910
Salt Sand	1730	"	1810
Big Lime	2160	"	2240
Big Injun Sand	2240	"	2320

Fifty-foot Sand	2805	"	2825
"Thirty-foot" Sand (gas, 2910′)	2910	"	2925
Stray Sand	2976	"	2986
Gordon Sand	3013	"	3017
Slate and shells to bottom	3017	"	3314

M. Davisson Well, No. 2.

Grant district. Harrison and Doddridge County line, one mile northwest of Salem. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1100		
Little Dunkard Sand	1530	to	1580
Salt Sand	1940	"	2000
Big Lime	2400	"	2458
Big Injun Sand	2458	"	2581
Fifty-foot Sand	3010	"	3055
Stray Sand (oil, 3160′)	3159	"	3171
Slate to bottom	3212	"	3215

Silas Fitro Well, No. 2.

One mile and a half southwest of Salem, Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1092	to	1095
Dunkard Sand	1590	"	1680
Salt Sand	1950	"	2000
Little Lime	2340	"	2380
Big Lime	2390	"	2440
Big Injun Sand	2442	"	2492
Fifty-foot Sand	3020	"	3040
Stray Sand	3128	"	3145
Gordon Sand	3165	"	3182
Total depth	3193		

John Irons Well, No. 1.

Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	765	to	772
Dunkard Sand	1285	"	1315
Salt Sand	1605	"	1680
Big Lime	2050	"	2120
Big Injun Sand	2120	"	2245
Fifty-foot Sand	2715	"	2750
Stray Sand	2806	"	2824
Slate	2824	"	2845
Gordon Sand	2845	"	2856
Slate to bottom	2856	"	2859

R. G. Davis Well, No. 3.

One mile northwest of Miletus, Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	800		
Dunkard Sand	1345	to	1385
Salt Sand	1780	"	1860
Big Lime	2130	"	2170
Big Injun Sand	2170	"	2255
Fifty-foot Sand	2660	"	2685
Stray Sand	2828	"	2840
Gordon Sand (oil, 2871')	2864	"	2877
Total depth	2902		

Marcellus Clark Well, No. 2.

One mile northwest of Miletus, Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	639		
Dunkard Sand	1164	to	1210
Salt Sand	1625	"	1685
Big Lime	1940	"	1990
Big Injun Sand	1990	"	2105
Fifty-foot Sand	2510	"	2535
Stray Sand	2679	"	2694
Gordon Sand (oil, 2719')	2716	"	2728
Total depth			2750

William Mowry Well, No. 1.

Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	700	to	704
Big Dunkard Sand	1195	"	1230
Salt Sand	1675	"	1850
Maxton Sand	2000	"	2035
Big Lime	2075	"	2125
Big Injun Sand	2125	"	2275
Berea	2475	"	2490
Fifty-foot Sand	2600	"	2635
Stray Sand	2770	"	2785
Gordon Sand	2798	"	2840
Fifth Sand (oil)	3004	"	3016
Total depth			3081

This farm lies in the eastern corner of Doddridge, along the southwest extension of the Wolf Summit and Jarvisville Fifth Sand developments where the interval from the Pittsburg coal to the Big Injun Oil Sand has thickened up greatly.

William Mowry Well, No. 2.

Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg? Coal (Sewickley)	550	to	556
Big Dunkard Sand	1050	"	1055
Salt Sand	1215	"	1450
Maxton Sand	1835	"	1955
Pencil cave	1955	"	1960
Big Lime	1960	"	2020
Big Injun Sand	2020	"	2089
Fifty-foot Sand	2442	"	2466
Stray Sand	2576	"	2585
Gordon Sand	2605	"	2645
Fifth Sand (oil)	2860	"	2868
Total depth			2878

Geo. T. Richards Well, No. 3.

Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	590	to	595
Little Dunkard Sand	912	"	937
Big Dunkard Sand	1030	"	1070
Salt Sand	1500	"	1685
Maxton Sand	1860	"	1935
Big Lime	1970	"	2035
Big Injun Sand	2035	"	2135
Fifty-foot Sand	2568	"	2593
Gordon Stray (oil, 2664′)	2651	"	2686
Gordon Sand	2699	"	2743
Fifth Sand	2893	"	2902
Total depth			2989

J. T. Somerville Well, No. 2.

Greenbrier district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	474	to	480
Big Dunkard Sand	1040	"	1085
Maxton Sand	1745	"	1825
Big Lime	1830	"	1895
Big Injun Sand	1900	"	1965
Fifty-foot Sand	2360	"	2390
Stray Sand	2472	"	2500
Gordon Sand	2580	"	2620
Fifth Sand (oil)	2784	"	2790
Total depth			2815

D. H. Nicholson Well, No. 1.

New Milton district. Authority South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	510	to	545
Big Dunkard Sand	1180	"	1255
Gas Sand	1340	"	1345
Salt Sand	1460	"	1545
Maxton Sand	1715	"	1720
Big Injun Sand	2075	"	2150
Gantz Sand	2345	"	2360
Gordon Sand	2658	"	2665
Fifth Sand			2824
Total depth			2906

Albert Pearcy Well, No. 2.

One mile north of Kelly Postoffice, New Milton district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal (Washington)	250	to	252
Bluff Sand (Waynesburg)	385	"	425
Dunkard Sand	1065	"	1090
"Second" Sand	1170	"	1220
Salt Sand	1360	"	1443
Second Salt Sand	1550	"	1580
Sand	1610	"	1685
Little Lime	1840	"	1855
Pencil cave	1870		
Sand (Maxton)	1872	"	1892
Big Lime	1892	"	1947
Big Injun Sand (gas, 1972′; oil, 1973 to 1980′)	1947	"	2042
Total depth			2047
(Thirty-barrel well.)			

W. B. Maxwell Well, No. 1.

One mile and a half south of Coldwater, New Milton district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	795	to	800
Little Dunkard Sand	1240	"	1280
Big Dunkard Sand	1325	"	1360
Gas Sand	1578	"	1620
Salt Sand	1690	"	1735
Maxton Sand	1995	"	2010
Little Lime	2050	"	2060
Big Lime	2226	"	2298
Big Injun Sand	2298	"	2423

Gantz Sand (oil, 2620′)	2608	"	2650
Total depth			2653

Here at the southeastern line of Doddridge, the interval from the Pittsburg coal to the Big Injun Sand has thickened to 1,500 feet, which is greater by 200 feet than the same interval on the O. B. Hardman farm at the Tyler-Doddridge line, 20 miles northwestward.

James Maxwell Well, No. 1.

New Milton district, two miles south of Market. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	800	to	860
Cow Run Sand (shell)	950		
Salt Sand	1410	"	1505
Maxton Sand	1740	"	1770
Big Lime	1960	"	2035
Big Injun Sand	2035	"	2110
Gantz Sand	2420	"	2422
Gordon Stray (shell)	2630		
Gordon Sand	2655	"	2659
Total depth			2862

W. M. Stout Well, No. 8.

Two miles west of Market. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	900	to	1200
Cow Run Sand	1250	"	1285
Salt Sand	1400	"	1500
Maxton Sand	1825	"	1850
Big Lime	1965	"	2040
Big Injun Sand	2040	"	2130
Gordon Sand	2673	"	2678
Total depth			2698

No coal found in any of the Stout wells except in No. 25, about two miles south from W. M. Stout No. 8, where a coal bed is reported three feet thick at 239 feet, but this would be above the Pittsburg horizon.

Mary E. Gabbert Well, No. 1.

New Milton district. Authority, South Penn Oil Company

"Hurry Up" Sand	220	to	275
Salt Sand	1181	"	1282
Maxton Sand	1400	"	1520
Little Lime	1641	"	1675

Pencil cave	1675	"	1685
Big Lime	1735	"	1794
Big Injun Sand (oil show, 1845′)	1794	"	1820
Gordon Sand	2452	"	2460
Total depth			2480

W. M. Williams Well, No. 1.

One mile and a half west of north of Leopold Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	700	to	1000
Cow Run Sand	1015	"	1060
Salt Sand	1310	"	1393
Maxton Sand (water, 1738′)	1730	"	1750
Big Lime	1830	"	1940
Big Injun Sand (gas, 1940′; water 1960′)	1940	"	2032
Squaw Sand	2165	"	2185
Gantz Sand	2350	"	2362
Gordon Stray	2544	"	2552
Gordon Sand (oil, 2564′)	2564	"	2570
Total depth			2587
(Thirty-barrel well.)			

John Wanstreet Well, No. 1.

One mile northwest of Leopold Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	715	to	1050
Cow Run Sand	1050	"	1070
Salt Sand	1275	"	1300
Maxton Sand	1570	"	1610
Big Lime	1887	"	1952
Big Injun Sand	1952	"	2047
Gantz Sand (gas, 2356′)	2346	"	2466
Gordon Stray (hard)	2524	"	2537
Gordon Sand (oil on top)	2539	"	2547
Total depth			2564
(Ten to twenty-barrel well.)			

L. G. Chapman Well, No. 1.

Near Grove Postoffice, Cove district. Authority, Southern Oil Company.

	Feet.		Feet.
Big Injun Sand (gas, 1858′)	1800	to	1900
Shells (at Gordon Sand horizon)	2440		
Slate and shells to bottom			2730

J. M. Gribble Well, No. 1.

Two and one-fourth miles northeast of St. Clara. Authority, Carter Oil Company.

	Feet.		Feet.
No coal.			
Cave	200		
Cow Run Sand	1200	to	1220
Salt Sand	1300	"	1560
Maxton Sand	1644	"	1684
Big Lime	2000	"	2100
Big Injun Sand	2100	"	2210
Stray Sand	2735	"	2740
Gordon Sand	2745	"	2750
Total depth			2770

Charles Fischer Well, No. 1.

Near Doddridge-Lewis line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	315		
Little Dunkard Sand	700		
Big Dunkard Sand	845		
Big Injun Sand	1710	to	1915
Gantz Sand (oil and water, 2165′)	2160	"	2186

Christian Albers Well, No. 1.

Near Doddridge-Lewis county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			324
Big Injun Sand (show of oil, 1890′)	1738	to	1890
Gantz Sand (oil, 2176′; water, 2178′)	2171	"	2201
Total depth			2207

James H. Bode Well. No. 1.

Cove district, three-fouths of a mile northeast of Grove Post-office. Authority, South Penn Oil Company.

	Feet.		Feet.
"Hurry Up" Sand	341		
Cow Run Sand	1090	to	1115
Salt Sand	1380	"	1452
Maxton Sand	1775	"	1825
Big Lime	1908	"	2007
Big Injun Sand	2007	"	2111
Stray Sand	2637	"	2647
Slate	2647	"	2653

Gordon Sand (oil, 2656′)	2653	"	2658
Total depth			2680

James H. Bode Well, No. 8.

Three-fouths of a mile northeast of Grove Postoffice. Authority, South Penn Oil Company.

	Feet.		Feet.
Black Cave	1110		
Cow Run Sand	1225	to	1310
Salt Sand (water, 1470′)	1455	"	1500
Maxton Sand	1725	"	1860
Big Lime	1980	"	2040
Big Injun Sand	2040	"	2150
Stray Sand	2665	"	2670
Slate	2670	"	2675
Gordon Sand (oil, 2676 to 2680′)	2675	"	2680

W. H. Bode Well, No. 1.

Cove district, three-fourths of a mile northeast of Grove Postoffice. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Sewickley?)	300	to	304
Big cave	900	"	1040
Cow Run Sand	1150	"	1180
Salt Sand	1400	"	1730
Maxton Sand	[illegible]	"	1820
Big Lime	1870	"	1935
Big Injun Sand	1935		
Sand (Berea?)	2190		
Stray Sand	2559	"	2564
Gordon Sand	2569	"	2574
Total depth			2595

The coal at 300 feet is not the Pittsburg, and it would appear to be close to the horizon of the Sewickley, or Macksburg bed.

John A. Bode Well, No. 1.

Cove district, three-fourths of a mile northeast of Grove Postoffice. Authority, South Penn Oil Company.

	Feet.		Feet.
Black cave	1154		
Cow Run Sand	1154	to	1224
Coal (Upper Freeport?)	1228	"	1234
Salt Sand	1424	"	1446
Second Salt Sand	1610	"	1640
Maxton Sand	1690	"	1750

Big Lime	1880	"	1964
Big Injun Sand	1964	"	2054
Stray Sand	2572	"	2592
Slate	2592	"	2597
Gordon Sand	2597	"	2602
Total depth			2612

John A. Bode Well, No. 2.

Cove district, three-fourths of a mile northeast of Grove Postoffice. Authority, South Penn Oil Company.

	Feet.		Feet.
Black cave	1200		
Cow Run Sand	1300	to	1360
Salt Sand	1540	"	1630
Maxton Sand	1760	"	1825
Big Lime	2050	"	2110
Big Injun Sand	2110	"	2215
Sand (Berea?)	2375	"	2485
Stray Sand	2738	"	2751
Slate	2751	"	2754
Gordon Sand (oil, 2755 to 2760′)	2754	"	2761
Total depth			2782

E. M. Gaston Well, No. 1.

Two miles southwest of Kelley Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	500	to	800
Cow Run Sand	895	"	925
Salt Sand (soft on top)	1250	"	1350
Maxton Sand (little gas, 1540′)	1425	"	1475
Big Lime (hard)	1600	"	1660
Big Injun Sand (gas, 1660′)	1660	"	1700
Sand (Berea?)	1880	"	2005
Pencil cave	2290	"	2295
Gordon Stray	2286	"	2290
Gordon Sand	2295	"	2297
Total depth			2500

(Good Injun gas well.)

Jacob Netzer Well, No. 1.

Arnolds creek, three miles southwest of West Union. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	310	to	313
Cave	590	"	790
Cow Run Sand	790	"	820
Salt Sand	1080	"	1155
Salt Sand	1305	"	1330

Maxton Sand (oil, 1490′)	1480	"	1502
Pencil cave	1605	"	1615
Big Lime	1615	"	1702
Big Injun Sand (gas, 1705′ and 1765′)	1702	"	1772
Berea? (poor)	1935	"	1960
Total depth of well			2493
"Gordon Stray" and Gordon Sand	None		

Hole filled up to 1794′ with oil; practically dry hole.

Harvey Smith Well, No. 1.

Three and one-half miles southwest of West Union. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	410	to	413
Cow Run Sand	800	"	820
Salt Sand	1200	"	1290
Maxton Sand	1630	"	1642
Big Lime	1660	"	1745
Big Injun Sand (big gas, 1750′)	1745		

In Harvey Smith well, No. 2, the Pittsburg coal is reported as only two feet thick at 470 feet.

L. E. Jones Well, No. 1.

One mile northwest of Morgansville. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cow Run Sand	860	to	885
Salt Sand	960	"	995
Big Lime	1678	"	1711
Big "Injun" Sand	1711	"	1845
Gordon Sand	2288	"	2314
Total depth	2723		

"Formations all broken, no Fifth Sand found."

Ed Kane Well, No. 1.

Three and one-half miles northwest of West Union. Authority, Carter Oil Company.

	Feet.		Feet.
No Coal.			
Cave	675	to	735
Cow Run Sand	900	"	940
Salt Sand	1200	"	1400
Big Lime	1630	"	1695
Big Injun Sand	1695	"	1798
Total depth			2479

Dan H. Harris Well, No. 2.

One mile and a half north of west of Central Station. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal (poor)	490	to	491
Cave (bad)	600	"	990
Cow Run Sand	990	"	1010
Salt Sand	1300	"	1365
Salt Sand	1560		
Pencil cave (bad)	1736	"	1746
Big Lime	1746	"	1795
Big Injun Sand (oil show, 1795′ and 1845′)	1795	"	1893
Total depth (shells)			2130

Williamson Heirs' Well, No. 1.

Long run, two miles northwest of Central Station. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal (poor)	460	to	461
Cave	700	"	905
Cow Run Sand	905	"	940
Salt Sand	1170	"	1480
Maxton Sand	1520	"	1532
Pencil cave	1685	"	1700
Big Lime	1700	"	1764
Big Injun Sand (oil and gas, 1782′)	1764	"	1864
Total depth			1879
(One-barrel well.)			

John Chisler Well, No. 1.

Three-fourths of a mile southwest of Central Station. Authority, Carter Oil Company.

Pittsburg Coal not reported, but probably none.

	Feet.		Feet.
Cave	780	to	1060
Cow Run Sand	1060	"	1080
Salt Sand	1314	"	1459
Maxton Sand	1645	"	1683
Big Lime	1852	"	1916
Big Injun Sand (show oil and gas, 1975′)	1916	"	1975
Berea Grit?	2235	"	2280
Gordon Sand (shells)	2625		
Total depth			3085
(Dry.)			

The sand marked Berea Grit by the driller is only 260 feet

below the Big Injun Sand, as against 360 feet for that interval along the Ohio river at Eureka, etc., and hence may not be identical with the Berea.

John Harris Well, No. 1.

Two miles north of west of Central Station. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	716	to	990
Cow Run Sand	990	"	1005
Salt Sand (water, 1245′)	1230	"	1295
Salt Sand	1400	"	1447
Maxton Sand	1515	"	1540
Big Lime	1727	"	1778
Big Injun Sand (gas, 1778 to 1786′)	1778	"	1871
Total depth			1910
(Fair gas well.)			

S. A. Hansford Well, No. 1.

On Arnolds creek, four miles southeast of Greenwood Postoffice. Authority, Carter Oil Company.

Pittsburg Coal	574	to	575
Cave	724	"	1055
Cow Run Sand	1055	"	1100
Salt Sand	1444	"	1624
Maxton Sand	1771	"	1793
Big Lime	1851	"	1943
Big Injun Sand (gas, small, 1963 to 1978′)	1935	"	2030
Total depth			2081

L. D. Stuck Well, No. 1.

Two miles south of Central Station. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	800	to	1050
Cow Run Sand	1105	"	1135
Salt Sand	1418	"	1658
Big Lime	1920	"	2000
Big Injun Sand	2000	"	2050
Berea?	2240	"	2340
Total depth			2828

D. H. Harris Well, No. 2.

One and three-fourths miles west of Central Station. Authority, W. H. Aspinwall, of the Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	490	to	491
Cave	600	"	990
Cow Run Sand	990	"	1010
Salt Sand at	1300		
Salt Sand at	1560		
Cave	1736	"	1746
Big Lime	1746	"	1795
Big Injun Sand	1795	"	1893
Berea? (shell) at			2130
Gordon (shell) at			2528
Bottom			2552

B. C. Powell Well, No. 1.

One and three-fourths miles west of Central Station. Authority, Carter Oil Company, by W. H. Aspinwall.

	Feet.		Feet.
Pittsburg Coal (poor)	550	to	552
Cave	700	"	1075
Cow Run Sand	1075	"	1110
Salt Sand	1345	"	1415
Salt Sand	1575	"	1625
Pencil cave	1800	"	1810
Big Lime	1810	"	1866
Big Injun Sand	1866	"	1921

W. L. Stinespring Well, No. 1.

Two miles northeast of Oxford, Central district. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	525	to	528
Cow Run Sand	1027	"	1047
Salt Sand	1300	"	1350
Maxton Sand	1745	"	1760
Big Lime	1800	"	1880
Big Injun Sand	1886	"	1946
Berea?	2100	"	2160
Total depth (no Gordon)			2655

HARRISON COUNTY WELL RECORDS.

Harrison county lies directly east from Doddridge and Wetzel, and hence its eastern half comes within the zone of the State's productive oil and gas belt. The Chestnut Ridge arch,

a very bold anticlinal ridge, passes across this county from northeast to southwest, three to four miles east from Clarksburg, and appears to have interrupted the accumulation of oil and gas into pools of commercial value, since within the confines of Harrison, neither oil nor gas has been found in paying quantity east from this uplift, or nearer its crest than four to five miles down its western slope. The oil sands are found when the drill is sent down, and they always contain a little oil and a little gas, but not enough of either to prove valuable.

A narrow strip along the western portion of Harrison, adjoining Wetzel and Doddridge counties contains all of the area in which oil has yet been produced in commercial quantity, but the gas fields extend 10 to 15 miles farther to the east.

The following records from Sardis district will exhibit the succession of the rocks in western Harrison, just east from the Wetzel county line:

A. H. Heldreth Well, No. 4.

Two miles southeast of Folsom, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1051	to	1055
Dunkard Sand	1550	"	1630
Salt Sand	1950	"	2030
Big Lime	2270	"	2350
Big Injun Sand	2350	"	2450
Fifty-foot Sand	2950	"	2980
Stray Sand (oil shows, 3116′ and 3138′)	3084	"	3152
Slate	3152	"	3162
Gordon Sand (pay, 3180′)	3162	"	3184
Slate	3184	"	3198
Total depth			3198

J. L. Lambert Well, No. 2.

Two and one-half miles southeast of Folsom, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Bluff Sand	755		
Pittsburg Coal	1185	to	1191
Little Dunkard Sand	1592		
Big Dunkard Sand	1682	"	1762
"Gas" Sand (Second Cow Run)	1930		
Salt Sand	2105	"	2263

Maxton Sand	2278		
Pencil cave	2376		
Big Lime	2384	"	2440
Big Injun Sand	2440	"	2540
Fifty-foot Sand	3042	"	3067
Thirty-foot Sand	3132	"	3167
Stray Sand (gas, 3223′)	3183	"	3235
Gordon Sand	3258	"	3278
Total depth			3284

(Thirty-barrel well.)

E. T. Bennett Well, No. 1.

At Alliance Postoffice, three and one-half miles north of Wallace, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Bluff Sand (Waynesburg)	500		
Pittsburg Coal	914	to	919
Dunkard Sand	1410	"	1440
Maxton Sand	2090		
Big Lime	2120	"	2168
Big Injun Sand	2185	"	2290
Gantz Sand	2730	"	2760
Fifty-foot Sand	2770	"	2790
Stray Sand	2970	"	3005
Gordon Sand (oil, 3018′)	3006	"	3044
Total depth			3067

M. E. Heldreth Well, No. 1.

Three miles north of Wallace, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	908	to	912
Dunkard Sand	1326		
Salt Sand	1442	"	1602
Little Lime	1937		
Pencil cave	1946	"	1958
Big Lime	1960	"	2019
Big Injun Sand	2019	"	2112
Fifty-foot Sand	2764	"	2800
Stray Sand	2937	"	2974
Gordon Sand (oil, 3003′)	2984	"	3018
Total depth			3033

(Fifty-barrel well.)

Omer E. Hall Well, No. 2.

Two miles northwest of Wallace, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Bluff Sand (Waynesburg)	742		

Pittsburg Coal	1153	to	1158
Dunkard Sand	1635	"	1678
Gas Sand (Second Cow Run)	1896	"	1930
Little Lime	2370	"	2380
Pencil cave	2380	"	2414
Big Injun Sand	2414	"	2528
Stray Sand	3165	"	3235
Gordon Sand	3239	"	3257
Fourth Sand	3270	"	3275
Total depth			3278

W. R. G. Hall Well, No. 3.

Two and one-half miles northwest of Wallace, Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Bluff Sand (Waynesburg)	785	to	825
Pittsburg Coal	1194	"	1199
Dunkard Sand	1790	"	1820
Salt Sand	2085	"	2220
Maxton Sand	2265	"	2325
Little Lime	2336	"	2346
Big Lime	2396	"	2461
Big Injun Sand	2461	"	2575
Fifty-foot Sand	3040	"	3065
Thirty-foot Sand	3130	"	3158
Stray Sand (gas, 3227 to 3237′)	3192	"	3257
Gordon Sand (oil, 3265 to 3271′)	3260	"	3278
Total depth			3299

L. E. Bartlett Well, No. 1.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	780		
Dunkard Sand	1270	to	1370
Gas Sand	1550	"	1590
Salt Sand	1680	"	1770
Big Lime	2006	"	2054
Big Injun Sand (gas, 2054′; oil, water, 2069′; show oil, 2160′)	2054	"	2181
Gantz Sand (show oil, 2510′)	2510	"	2540
Fifty-foot Sand	2610	"	2650
Gordon Sand (oil, 2866′ and 2872′)	2854	"	2888
Black sand and slate	2888	"	2893
Sand, Gordon	2893	"	2902

L. E. Bartlett Well, No. 3.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	970		

Dunkard Sand	1465	to	1510
Gas Sand	1550	"	1630
Salt Sand	1700	"	1980
Maxton Sand	2075	"	2115
Pencil cave	2175	"	2180
Big Lime	2180	"	2240
Big Injun Sand	2240	"	2375
Fifty-foot Sand	2825	"	2865
"Bowlder" Sand	2940	"	2960
Stray Sand (gas, 3021')	2980	"	3027
Slate	3027	"	3045
Sand, Gordon	3045	"	3070
Slate (break)	3070	"	3077
Sand (Gordon)	3077	"	3089
Slate	3089	"	3115
Total depth			3115

In these wells the Gordon Sand is split by a parting of slate five feet thick in No. 1 and seven feet in No. 3.

G. W. Talkington Well, No. 6.

Two miles north of Wallace, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal, Pittsburg	995	to	1000
Dunkard Sand	1400	"	1450
Gas Sand	1500	"	1575
Salt Sand	1900	"	1980
Little Lime	2100	"	2125
Pencil cave	2125	"	2130
Big Lime	2130	"	2210
Big Injun Sand	2210	"	2345
Fifty-foot Sand	2895	"	2920
Stray Sand	3025	"	3065
Gordon Sand (oil, 3082' and 3091')	3075	"	3095

James Ogden Well, No. 1.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	995		
Big Dunkard Sand	1480	to	1560
Gas Sand	1600	"	1640
Salt Sand	1890	"	1990
Maxton Sand	2120	"	2150
Big Lime	2200	"	2280
Big Injun Sand	2290	"	2390
Gantz Sand	2745	"	2775
Fifty-foot Sand	2830	"	2880
"Bowlder" Sand ("Thirty-foot")	2946	"	2971

Stray Sand	3025	"	3050
Gordon Sand (oil show, 3094′)	3063	"	3103
Total depth			3149

J. L. Lambert Well, No. 1.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1126		
Little Dunkard Sand	1520	to	1560
Big Dunkard Sand	1610	"	1660
"Gas" Sand (Second Cow Run)	1800	"	1880
Salt Sand	2040	"	2120
Pencil cave	2310	"	2315
Big Lime	2315	"	2375
Big Injun Sand	2375	"	2500
Fifty-foot Sand	2800	"	2840
"Bowlder" Sand ("Thirty-foot")	3080	"	3100
Stray Sand	3115	"	3180

J. J. Ashcraft Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	785		
Dunkard Sand	1280	to	1330
Gas Sand	1525	"	1585
Maxton Sand	1932	"	2010
Big Lime	2012	"	2050
Big Injun Sand	2050	"	2177
Fifty-foot Sand	2625	"	2660
Stray Sand	2792	"	2834
Gordon Sand (gas, 2859′; oil, 2861′)	2858	"	2878
Slate	2878	"	2890
Hard shells	2890	"	2896
Slate and shells to bottom	2896	"	2930

J. J. Ashcraft Well, No. 2.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	975		
Dunkard Sand	1450		
Gas Sand	1770		
Salt Sand	1930		
Big Lime	2115		
Big Injun Sand	2270	to	2388
Gantz Sand	2710		
Fifty-foot Sand	2840		
Stray Sand	2920	"	3045
Slate	3045	"	3055
Gordon Sand	3055	"	3083
Slate to bottom	3083	"	3127

T. D. Rogers Well, No. 1.

Two miles west of Olive, Ten Mile district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1053	to	1058
Dunkard Sand	1770	"	1800
Big Lime	2290	"	2350
Big Injun Sand	2350	"	2450
Fifty-foot Sand	2895	"	2910
Thirty-foot Sand	2970	"	3000
Stray Sand	3040	"	3100
Gordon Sand (oil, 3140 to 3147′)	3129	"	3160
Total depth			3160

(Two hundred and seventy-five-barrel well.)

W. A. Rogers Well, No. 2.

Two and one-half miles west of Olive, Sardis district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	950	to	956
Dunkard Sand	1450	"	1520
Salt Sand	1830	"	1900
Big Lime	2200	"	2260
Big Injun Sand	2260	"	2362
Fifty-foot Sand	2825	"	2856
Thirty-foot Sand	2930	"	2950
Stray Sand	2970	"	3004
Gordon Sand (oil, 3037 to 3042′)	3026	"	3060
Total depth			3060

Large well.

Marshall Bailey Well, No. 1.

Sardis district. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	295		
Maxton Sand	1530		
Big Injun Sand	1660		
Gordon Sand	2369	to	2387 (Dry)
Bottom			2742

Seth Piggott Well, No. 1.

Sardis district. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	622		
Pencil cave	1860		
Big Lime	1880	to	1940
Big Injun Sand	1940		
Gantz Sand	2515		

"Thirty-foot" Sand	2671	"	2720
"Break" red rock	2724		
Gordon Sand	2750	"	2780
Fourth Sand	2782	"	2806
Fifth Sand	2839	"	2845

J. L. Swiger Well, No. 1.

Laurel run, one mile and a half northeast of Brown. Authority, Hartman Oil Company.

	Feet.		Feet.
Bluff Sand (Waynesburg)	140	to	160
Pittsburg Coal	558		
Dunkard Sand	1075		
Gas Sand	1356	"	1470
Salt Sand	1500	"	1640
Big Injun Sand	1855	"	1965
Gantz Sand	2445	"	2470
Gordon Sand	2682	"	2694
Gordon Sand	2717	"	2733
Fourth Sand	2773	"	2780
Sand, hard	3218	"	3225
Bottom			3635

This well was drilled to 3,077 feet below the Pittsburg coal, and should have penetrated the Speechley Sand horizon at that depth, since it comes at 860 feet below the Fourth Sand of the Venango series, which was struck here at 2,159 feet below the Pittsburg bed.

Felix Coffman Well, No. 1.

Two miles northeast of Sedalia, near Doddridge-Harrison line. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	865	to	875
Cow Run Sand	1400	"	1425
Salt Sand	1600	"	1700
Maxton Sand	1940	"	2045
Big Lime	2120	"	2180
Big Injun Sand	2180	"	2270
Berea?	2625	"	2637
Pencil cave	2875	"	2890
Gordon Stray (gas, 2920′)	2890	"	2928
Gordon Sand (gas, 2940′)	2935	"	2945
Total depth			2972

"Good gas well."

Milton Davis Well, No. 1.

Near Harrison and Doddridge line. Authority South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1175		
Dunkard Sand	1600	to	1650
Salt Sand	2045	"	2095
Big Lime	2458	"	2518
Big Injun Sand	2518	"	2621
Stray Sand (gas, 3247′)	3245	"	3262
Slate	3262	"	3286
Sand, Gordon	3286	"	3302
Slate to bottom	3302	"	3343

E. V. Smith Well, No. 1.

Two and one-fourth miles southeast of Sedalia, near Doddridge line, Ten Mile district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	1088	to	1093
Little Dunkard Sand	1493	"	1530
Big Dunkard Sand	1628	"	1670
Maxton Sand	2250	"	2300
Big Lime	2331	"	2390
Big Injun Sand	2390	"	2496
Fifty-foot Sand	2960	"	3000
Stray Sand	3098	"	3122
Gordon Sand (oil, 3151′)	3148	"	3172
Total depth			3427

S. C. Barnes Well, No. 1.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	955	to	961
Big Dunkard Sand	1495	"	1540
Salt Sand	2000	"	2085
Big Lime	2245	"	2305
Big Injun Sand	2305	"	2360
Fifty-foot Sand	2820	"	2850
"Thirty-foot" Sand	2900	"	2935
Sand, Stray	2988	"	3009
Slate	3009	"	3024
Sand, Gordon (oil, 3026′)	3024	"	3044

T. C. Bennett Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Bluff Sand (Waynesburg)	555	to	590
Mapletown Coal (Sewickley)	804	"	808

Pittsburg Coal	924	"	934
Sand, Connellsville	1050	"	1080
Red rock	1080	"	1330
Big Dunkard Sand	1454	"	1500
Gas Sand	1715	"	1750
Salt Sand	1850	"	1885
Maxton Sand	1990	"	2040
Little Lime	2100	"	2120
Big Lime	2200	"	2232
Big Injun Sand	2232	"	2332
Fifty-foot Sand	2820	"	2830
Stray Sand	2943	"	2986
Slate	2986	"	3000
(Gordon) Sand	3000	"	3042
Slate to bottom	3042	"	3083

T. C. Bennett Well, No. 3.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1012	"	1020
Little Dunkard Sand	1410	"	1450
Big Dunkard Sand	1520	"	1600
Sand and slate	1750	"	2275
Big Lime	2275	"	2310
Big Injun Sand	2310	"	2415
Gantz and Fifty-foot (gas, 2880′)	2870	"	2910
Red rock	3035	"	3040
Sand (Stray)	3058	"	3070
Red rock	3078	"	3080
Slate	3080	"	3094
Gordon Sand (oil, 3098′)	3094	"	3117
Slate to bottom	3117	"	3165

A. F. Dennison Well, No. 1.

Three and one-half miles northeast of Salem, Ten Mile district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	930	to	935
Dunkard Sand	1410	"	1450
Gas Sand	1670	"	1700
Big Lime	2150	"	2205
Big Injun Sand	2205	"	2300
Fifty-foot Sand	2750	"	2778
Thirty-foot Sand	2850	"	2875
Stray Sand	2900	"	2960
Gordon Sand	2997	"	3029
Total depth			3324

(Dry hole.)

J. W. Williams Well, No. 1.

Three miles north of Salem. Authority, United States Oil Company.

	Feet.		Feet.
Pittsburg Coal	710		
Big Injun Sand	2010		
(Gas, 2560′, probably in Gantz or Fifty-foot.)			
Gordon Sand (oil, 2786′)	2786	to	2810

J. W. Williams Well No. 2.

	Feet.		Feet.
Pittsburg Coal	825		
Big Injun Sand	2115		
Fifty-foot Sand (gas)	2677		
Gordon Sand (oil, 2897′)	2886	to	2907

J. W. Williams Well No. 6.

	Feet.		Feet.
Pittsburg Coal	890		
"Thirty-foot" Sand (gas)	2825		
Stray Sand (oil)	2941		
Gordon Sand (oil, 2971′)	2968	to	2992

Luther Haymond Well No. 1.

Three and one-half miles northeast of Salem. Ten Mile District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1215	to	1220
Dunkard Sand	1735	"	1750
Salt Sand	2005	"	2100
Pencil cave	2445	"	2450
Big Lime	2450	"	2525
Big Injun Sand	2525	"	2620
Fifty-foot Sand	3180	"	3210
Sand ("Thirty-foot;" show of oil, 3257′)	3257	"	3273
Slate	3273	"	3299
Sand (Gordon; oil, 3300′)	3299	"	3318
Slate and shells to bottom	3318	"	3609

Luther Haymond Well No. 6.

	Feet.		Feet.
Pittsburg Coal	1065	to	1071
Dunkard Sand	1615	"	1700
Salt Sand	2065	"	2175
Big Lime	2320	"	2380
Big Injun Sand	2380	"	2450
Fifty-foot Sand	2915	"	2957
"Thirty-foot" Sand	3027	"	3060
Stray Sand	3075	"	3115

Gordon Sand	3130		
Total depth			3151

Luther Haymond Well No. 16.

(Steel line.)	Feet.		Feet.
Pittsburg Coal	900	to	905
Salt Sand	1750	"	1810
Big Injun Sand	2212	"	2290
Stray Sand	2923	"	2941
Gordon Sand ("pay," 2960 to 2960-9')	2957	"	2975
Total depth			3060

J. Lough Well, No. 1.

Two miles northwest of Marshville. Authority, Gartlan Drilling Co.

	Feet.		Feet.
Bluff Sand (Waynesburg)	500	to	550
Pittsburg Coal	935	"	940
Little Dunkard Sand	1310	"	1400
Big Dunkard Sand	1430	"	1460
Salt Sand	1760	"	1875
Maxton Sand	2120	"	2145
Little Lime	2160	"	2180
Pencil cave	2180	"	2195
Big Lime	2195	"	2260
Big Injun Sand	2260	"	2345
"Fifty-foot Sand (gas, 2805 to 2820')	2805	"	2825
"Thirty-foot" Sand	2900	"	2920
Gordon Stray Sand	2975	"	2990
Gordon Sand (oil, 3021')	3005	"	3038
Total depth			3038

Forty-barrel well.

E. Thompson Well No. 1.

On Jacobs Run near Salem. Authority, Star Oil and Gas Company.

	Feet.		Feet.
Coal Pittsburg	814	to	820
Dunkard Sand	1250	"	1295
Second Dunkard Sand	1345	"	1395
Salt Sand	1685	"	1850
Maxton Sand	1950	"	2020
Little Lime	2055	"	2073
Pencil cave	2073	"	2100
Big Lime	2100	"	2157
Big Injun Sand (oil, gas and water 2163')	2157	"	2235
Berea Grit	2548	"	2558
Fifty-foot Sand	2668	"	2680
"Thirty-foot" Sand (gas, 2765')	2760	"	2780

Gordon Stray (gas, 2832′)	2830	"	2845
Gordon Sand (oil, 2873 to 2880′)	2870	"	2886
Total depth			2886

"Fifty-barrel oil well and fair gas well."

Martha Frough Well No. 1.

In Salem. Authority Gartlan Drilling Company.

	Feet.		Feet.
Native Coal (Washington)	230	to	234
Bluff Sand (Waynesburg)	440	"	475
Pittsburg Coal	780	"	786
Little Dunkard Sand	1240	"	1265
Big Dunkard Sand	1305	"	1330
Maxton Sand	1950	"	2020
Little Lime	2050	"	2072
Pencil cave	2072	"	2080
Big Lime	2080	"	2135
Big Injun Sand	2135	"	2220
Berea Grit	2510	"	2524
Fifty-foot Sand	2626	"	2657
"Thirty-foot" Sand	2700	"	2715
Gordon Stray Sand	2790	"	2815
Gordon Sand (gas and oil, 2850 to 2860′)	2847	"	2864
Total depth			2868

"Well shot with 50 quarts; filled up 100 feet with oil in three hours; probably about four to six-barrel well."

Samuel Cain Well No. 1.

One mile southwest of Salem. Ten Mile District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1020	to	1028
Dunkard Sand	1550	"	1581
Salt Sand	1840	"	1950
Big Lime	2270	"	2330
Big Injun Sand	2330	"	2450
Fifty-foot Sand	2843	"	2893
"Thirty-foot" Sand	2953	"	2970
Gordon Stray (gas, 3030′)	3027	"	3045
Gordon Sand (oil, 3077′)	3073	"	3083
Total depth			3433

In the vicinity of Cherry Camp a well was drilled by Despard and Company, and the record kept with much detail by Mr. C. F. Despard of Clarksburg, a copy of which reads as follows:

Robinson Well No. 1.

On Raccoon Run, near Cherry Camp. Authority, Chas. Despard et al.

	Feet.		Feet.
Conductor	0	to	10
Red slate	90	"	100
Fire clay	4	"	104
Soapstone	17	"	121
Red shale	18	"	139
Red sand	2	"	141
Red shale	3	"	144
Black shale	6	"	150
Washington Coal	2	"	152
Black shale	8	"	160
Blue shale	32	"	192
White sand	31	"	223
Blue shale	7	"	230
Dark shale	7	"	237
Coal (Waynesburg "A")	2	"	239
Shale, red	11	"	250
White sand	12	"	262
Red rock	20	"	282
Blue shale	30	"	312
White sand	25	"	337
Red shale	30	"	367
Blue shale	54	"	421
Black shale	10	"	431
Coal (Uniontown)	2	"	433
Blue shale	23	"	456
Red shale	10	"	466
Variegated shale	70	"	536
Lime	35	"	571
Blue shale	30	"	601
Sand	25	"	626
Brown shale	68	"	694
Coal (Redstone)	3	"	697
Blue shale	19	"	716
Pittsburg Coal, top at 720′	6	"	726
Blue shale	104	"	830
Gray Sand	15	"	845
Red shale	43	"	888
Blue shale	46	"	934
Red rock	50	"	984
Blue shale	85	"	1069
White sand (Dunkard)	30	"	1099
Black shale	35	"	1134
Blue shale	135	"	1269

Lime	22	"	1291
Black slate	77	"	1368
Dark sand	80	"	1448
Blue slate	40	"	1488
Black slate	60	"	1548
Salt Sand, brown	115	"	1663
Blue slate	35	"	1698
Black slate	60	"	1758
Lime	40	"	1798
Slate	7	"	1805
Lime	23	"	1828
Red rock	40	"	1868
Lime	15	"	1883
Gray sand	17	"	1900
Pencil cave	4	"	1904
Little Lime and Big Lime (unrecorded)	132	"	2036
Big Injun, top, 2036′	174	"	2200
Blue slate	70	"	2270
Sandy slate	70	"	2340
Slate and shells	50	"	2390
Blue slate	90	"	2480
Brown sand	25	"	2505
White slate	83	"	2588
White sand, Berea Grit (Gantz)	15	"	2603
Blue slate	9	"	2612
White sand	6	"	2618
White slate	32	"	2650
Blue slate	20	"	2670
Hard sand	25	"	2695
Sand and shale	40	"	2735
Gray sand ("Thirty-foot")	15	"	2750
Red sand	25	"	2775
Slate	13	"	2778
Gordon Sand (top, 2808′)	35	"	2823
Blue shale	69	"	2892
White Sand (Fourth)	6	"	2898
Blue shale	104	"	3002
Dark sand and shale (5th Sand)	5	"	3007
Shale	25	"	3032
Total depth			3146
(Dry hole.)			

Some of the measurements as noted in the record do not correspond with the footings as added up in detail, but the discrepancy is slight and probably due to measurements with steel line at important horizons. The "Little Lime" which belongs just under the Maxton Sand, and also the "Big Lime" which comes on top of the Big Injun Sand, a total thickness of 132 feet

of measures have by inadvertency been dropped from the driller's "log", but the omission is corrected by his noting the depth to the top of the Big Injun Sand.

A well marked anticlinal uplift passes into Harrison county from Marion near Sturms Mill on Big Bingamon creek, and continuing on southwestward crosses main Ten Mile creek near Sardis, and the B. & O. R. R. half-way between Wilsonburg and Wolf Summit, and on southwestward east from Jarvisville. On the western slope of this arch (which has been termed the Wolf Summit Anticlinal), the dip is very rapid—200 to 250 feet to the mile, but eastward the dip is gentle, and the rocks do not descend more than 75 to 100 feet. Along the crest of this arch and eastward to the vicinity of Clarksburg where the strata again begin to rise eastward on the western slopes of the great Chestnut Ridge arch, we find one continuous gas field extending on southwestward across Harrison and into Lewis where it over-rides even the Chestnut Ridge anticlinal (much reduced in altitude southwestward) in the vicinity of Weston where we find the largest gas wells in the State. On the western slope of the Wolf Summit arch, and about two miles northwest from its crest a fine oil pool has been developed in the same sand which holds the gas to the east. This sand comes at 2300 to 2310 feet below the Pittsburg coal, and the writer has identified it with the Fifth or McDonald Oil Sand of the Pennsylvania series, and the oil fraternity uses the same term for its designation. This Fifth Sand pool is not wide (only 2000 to 2500 feet) since it occurs half way down the steeply dipping western slope of the Wolf Summit anticline where the elevation of the oil sand descends about 100 feet between the eastern and western edges of the pool.

The following records cover the region where this Fifth Sand is productive of either oil or gas and will serve to show its relation to the higher measures:

Dorothy Young Well, No. 1.

Ten Mile district. Authority, C. G. Elliott, of the Fearless Oil Company, Sistersville, W. Va.

	Feet.	Feet.
Coal (Washington)	45	

Coal (Uniontown)	360		
Mapletown Coal (Sewickley)	560		
Pittsburg Coal	640		
Big Dunkard Sand	1200		
"Blue Monday" (Maxton Sand) gas	1940	to	1960
Pencil cave	1960		
Big Lime	1970		
Big Injun Sand (gas, 2100′)	2030	"	2140
Fifty-foot Sand (gas)	2465		
Stray Sand (gas)	2655	"	2710
Gordon Sand (strong gas)	2723	"	2755
Fifth Sand (oil, small)	2935	"	2940
Total depth			2950

"Oil filled up 160 feet in one hour."

G. W. Albright Well, No. 1.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	696	to	703
Big Dunkard Sand	1222	"	1327
Salt Sand	1620	"	1670
Big Lime	2049	"	2130
Big Injun Sand	2135	"	2200
Fifty-foot Sand	2585	"	2610
Stray Sand (oil show, 2805′)	2790	"	2825
Gordon Sand (heavy gas)	2840		
Fifth Sand (oil show)	3033	"	3039

G. W. Albright Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	695	to	702
Big Dunkard Sand	1245	"	1297
Gas Sand	1425	"	1495
Salt Sand	1690	"	1784
Maxton Sand	1910	"	1995
Little Lime	2000	"	2012
Big Lime	2025	"	2098
Big Injun Sand	2098	"	2175
Fifty-foot Sand	2585	"	2615
Stray Sand (oil show, 2743′)	2737	"	2769
Gordon Sand	2784	"	2815
Fifth Sand (oil)	3002	"	3009

G. W. Albright Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	750	to	758
Little Dunkard Sand	1090	"	1120
Big Dunkard Sand	1285	"	1335
Maxton Sand (water, 1933′)	1930	"	2015

Red rock	2090		
Big Lime	2100	"	2190
Big Injun Sand	2190	"	2240
Berea	2510	"	2550
Fifty-foot Sand	2635		
Thirty-foot Sand	2720	"	2755
Stray Sand	2795	"	2845
Gordon Sand	2855	"	2900
Fifth Sand (oil)	3055	"	3061

The driller has identified with the Berea Grit of Ohio, a sand which was struck at 1752 feet below the Pittsburg coal, and 125 feet above the Fifty-Foot Sand. Each of these three records reveals something not given in the other two.

J. M. Fultz Well, No. 4.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	463	to	469
Dunkard Sand	1024	"	1052
Salt Sand	1400	"	1440
Big Lime	1797	"	1870
Big Injun Sand	1870	"	1942
Fifty-foot Sand	2352	"	2378
Stray Sand	2478	"	2500
Gordon Sand	2521	"	2548
Fifth Sand	2761	"	2773
Total depth	2791		

J. M. Fultz Well, No. 6.

	Feet.		Feet.
Pittsburg Coal	700	to	706
Little Dunkard Sand	1075		
Big Dunkard Sand	1215	"	1305
Maxton Sand	1968	"	2020
Big Lime	2048	"	2130
Big Injun Sand	2130	"	2218
Fifty-foot Sand	2588	"	2620
Stray Sand	2705		
Gordon Sand	2800		
Fifth Sand	3008	"	3015
Total depth			3028

L. J. Ayers Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	755	to	761
Gas Sand (show oil)			1455
Maxton Sand	2025	"	2080
Big Injun Sand	2200	"	2280

Fifty-foot Sand	2690	"	2702
Stray, Gordon Sand (gas, 2860′)	2830	"	2890
Fourth Sand	2900	"	2940
Fifth Sand (oil in top)	3050	"	3056

B. F. Bonner Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	745	to	750
Gas Sand	1590	"	1645
Big Lime	2120	"	2190
Big Injun Sand	2190	"	2320
Stray and Gordon Sands	2782	"	2855
Fifth Sand	3017	"	3022
Total depth			3045

B. F. Bonner Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	720	to	726
Big Dunkard Sand	1220	"	1250
Big Lime	2125	"	2195
Big Injun Sand	2195	"	2300
Fifty-foot Sand	2690	"	2710
Stray Sand (gas, 2780′)	2765	"	2785
Gordon Sand (oil, 2795′)	2790	"	2810
Fifth Sand	3017	"	3028

B. W. Cunningham Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	696	to	702
Big Lime	2066	"	2500
Big Injun Sand	2100	"	2180
Fifty-foot Sand	2670	"	2700
Stray Sand	2741	"	2780
Gordon Sand	2794	"	2830
Fifth Sand (oil)	2989	"	2994

L. E. Barnett Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	478		
Dunkard Sand	900		
Big Injun Sand	1925	to	1960
Stray Sand (gas)	2560	"	2580
Fifth Sand (oil and gas, 2780′)	2778	"	2786
Bottom			2800

Genius Payne Well, No. 2.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	490		
Big Injun Sand	1900		
Stray Sand	2609		
Gordon Sand	2620	to	2654
Fourth Sand	2704		
Fifth Sand	2825		
Total depth	2909		

A. C. Bailey Well, No. 1.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	1145	to	1150
Dunkard Sand	1630	"	1640
Salt Sand	1985	"	2100
Pencil cave	2490	"	2498
Big Lime	2498	"	2560
Big Injun Sand	2560	"	2630
Fifty-foot Sand	3065	"	3085
Stray Sand (gas, 3175′)	3175	"	3184
Slate	3184	"	3224
Gordon Sand (oil, 3230′)	3224	"	3243
Slate	3243	"	3253
Lime	3253	"	3268
Sand and shells	3268	"	3288
Slate	3288	"	3399
Lime and shells	3399	"	3403
Slate	3403	"	3411
Fifth Sand	3411	"	3415
Slate to bottom	3415	"	3483

In some portions of this Fifth Sand belt of oil and gas the producing stratum appears to shift down to an interval of 40 to 50 feet more below the Pittsburg coal than the average (2310 feet) but whether this is due to the drillers identifying the *Redstone coal,* 40 to 50 feet above the Pittsburg bed, with the latter stratum, or whether the producing sand shifts down to the Bayard horizon is not yet certainly known. The records of wells north from the B. & O. R. R. exhibit this greater interval as follows:

C. L. Griffith Well, No. 4.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	300	to	307

Big Dunkard Sand	800	"	850
Gas Sand	900	"	940
Salt Sand	1050	"	1130
Big Lime	1660	"	1740
Big Injun Sand	1740	"	1815
Fifty-foot Sand	2215	"	2245
Stray and Gordon Sands	2340	"	2470
Fourth Sand	2490	"	2515
Fifth Sand (Bayard?)	2670	"	2678
Total depth			2719

R. A. Flowers Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	300	to	306
Big Lime	1645	"	1722
Big Injun Sand	1725	"	1815
Fourth Sand	2535	"	2560
Fifth Sand (Bayard?)	2660	"	2664

R. A. Flowers Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	600	to	605
Dunkard Sand	1100	"	1120
Salt Sand	1570	"	1620
Big Lime	1944	"	2025
Big Injun Sand	2025	"	2080
Fifty-foot Sand	2531	"	2562
Gordon Sand	2735	"	2750
Fifth Sand (Bayard?)	2963	"	2972

R. S. Davisson Well, No. 1.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Redstone coal	250		
Pittsburg Coal	278	to	286
Little Dunkard Sand	667	"	750
Big Dunkard Sand	790	"	820
Red rock	1465	"	1550
Maxton Sand (little gas)	1550	"	1645
Big Lime	1650	"	1725
Big Injun Sand	1725	"	1785
Fifty-foot Sand	2245	"	2275
Stray Sand	2335	"	2360
Gordon Sand	2375	"	2530
Fifth Sand (Bayard?)	2660	"	2666
Total depth			2687

D. Boughner Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	500	to	505
Big Dunkard Sand	1030	"	1095
Big Lime	1865	"	1920
Big Injun Sand	1920	"	2000
Fifty-foot Sand	2425	"	2455
Gordon Sand	2630	"	2700
Fifth Sand (Bayard?)	2867	"	2879

Martha Smith Well, No. 3.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	470	to	475
Big Dunkard Sand	970	"	1000
Salt Sand	1500	"	1525
Big Lime	1831	"	1908
Big Injun Sand	1908	"	1960
Fifty-foot Sand	2415	"	2440
Gordon Sand	2637	"	2677
Fourth Sand	2683	"	2698
Fifth Sand	2831		
Total depth			2860

Amos Carter Well, No. 5.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	575	to	580
Cow Run Sand	1085	"	1125
Gas Sand	1280	"	1360
Salt Sand	1530	"	1580
Maxton Sand	1825	"	1900
Big Lime	1900	"	1980
Big Injun Sand	1980	"	2040
Fifty-foot Sand	2565	"	2575
Gordon Sand	2720	"	2780
Fifth Sand	2922	"	2928
Total depth			3000

John Flaherty Well, No. 1.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	418	to	423
Dunkard Sand	950	"	990
Maxton Sand	1720	"	1780
Big Lime	1780	"	1830
Big Injun Sand	1840	"	1910
Thirty-foot Sand	2430	"	2500

Fourth Sand	2588	"	2630
Fifth Sand	2824	"	2832
Bottom			2844

B. H. Brown Well, No. 12.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	400	to	408
Big Dunkard Sand	920	"	1040
Gas Sand	1100	"	1180
Salt Sand	1320	"	1400
Maxton Sand	1680	"	1760
Big Lime	1770	"	1830
Big Injun Sand	1830	"	1920
Fifty-foot Sand	2330	"	2370
"Thirty-foot" Sand	2460	"	2475
Gordon Stray	2480	"	2500
Gordon Sand	2515	"	2575
Fourth Sand to bottom			2610

B. H. Brown Well, No. 13.

Ten Mile district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	195	to	198
Little Dunkard Sand	700	"	750
Maxton Sand	1510	"	1550
Big Lime	1550	"	1590
Big Injun Sand	1590	"	1640
Fifty-foot Sand	2145	"	2160
Thirty-foot Sand	2265	"	2275
Gordon Sand	2327	"	2367
Fourth Sand	2397		
Fifth Sand	2560	"	2568
Total depth			2578

Edith Starkey Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal			332
Big Injun Sand, top	1787		
First pay	1792		
Stray Sand, top	2420		
Gordon Sand	2430	to	2450
Fourth Sand	2550		
Fifth Sand	2638	"	2645
Total depth			2677

Henry Brown Well, No. 1.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	414	to	420
Little Dunkard Sand	815	"	875
Red rock	1580	"	1720
Little Lime	1727	"	1750
Big Lime	1760	"	1856
Big Injun Sand	1856	"	1912
Fifty-foot Sand	2375	"	2400
Stray Sand	2440	"	2500
Gordon Sand	2503	"	2625
Fifth Sand (Bayard?) oil	2797	"	2803
Bottom			2828

A. J. Strother Well, No. 1.

Sardis district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	325	to	332
Big Dunkard Sand	844	"	914
Salt Sand	1312	"	1397
Big Lime	1690	"	1756
Big Injun Sand	1756	"	1831
Fifty-foot Sand	2267	"	2287
Gordon Sand	2410	"	2546
Fifth Sand (Bayard?) oil	2710	"	2720
Total depth			2725

Quintilla Boggess Well, No. 1.

Two miles west of Lumberport, Eagle district. Authority, South Penn Oil Company.

	Feet.		Feet.
Little Dunkard Sand	325	to	355
Big Dunkard Sand	435	"	490
Gas Sand	645	"	724
Salt Sand	745	"	945
Little Lime	1285	"	1300
Pencil cave	1300	"	1305
Big Lime	1305	"	1360
Big Injun Sand (gas, 1380′)	1360	"	1380
Fifty-foot Sand	1850	"	1900
Stray Sand	1925	"	1955
Gordon Sand	1975	"	2115
Fourth Sand (gas, 2165′)	2135	"	2190
Fifth Sand (Bayard?) (gas, 2317′)	2315	"	2320
Total depth			2347

(Gas well). This well begins about 70 feet below the Pittsburg coal.

James Coffman Well, No. 1.

Head of Cunningham Run. Authority, Mr. Guthrie, Superintendent of the Fairmont and Grafton Gas Company.

	Feet.		Feet.
Pittsburg Coal	97		
Big Injun Sand (gas, 1520′)	1516	to	1558
Berea Sand, grayish white (gsa, 1852′)	1850	"	1852
Fifty-foot Sand (shells)	1968		
Fourth Sand	2305	"	2321
Fifth Sand	None		
Bayard Sand (gas, 2480′)	2478	"	2485

"Sand dark and full of white pebbles. Drilled to 2808 feet, but found no more sand below the Bayard. The formation was composed of white and black slate and a few thin limy shells. Small gas well, good for a million feet."

Robert W. Coon Well, No. 1.

Two miles north of Clarksburg, on Jack's Run. Authority, Thomas D. Shaffer, Superintendent of the Mandell Oil and Gas Company. Pittsburg coal 25 feet above derrick floor.

	Feet.		Feet.
Limestone	20	to	94
Coal	94	"	96
Slate	96	"	115
Limestone	115	"	206
Slate	206	"	213
Coal (Elk Lick)	213	"	219
Slate	219	"	280
Lime	280	"	340
Sand	340	"	375
Lime	375	"	390
Coal (Bakerstown)	390	"	396
Little Dunkard Sand	396	"	480
Water and black oil			410
Slate	480	"	515
Coal (Upper Freeport)	515	"	518
Slate	518	"	545
Sand	545	"	690
Slate	690	"	710
Coal (Kittanning)	710	"	712
Slate	712	"	748
Salt Sand (water, 786′ and 805′)	748	"	835
Slate	835	"	847
Lime	847	"	860
Salt Sand, base (water, 870′)	860	"	940
Slate	940	"	980

Lime	980	"	1015
Sand, (Maxton?)	1015	"	1090
Lime	1090	"	1120
Slate	1120	"	1165
Red rock	1165	"	1360
Slate	1360	"	1395
Pencil cave	1395	"	1405
Big Lime	1405	"	1460
Big Injun Sand	1460	"	1570
Slate	1570	"	1582
Lime shells	1582	"	1592
Red rock	1592	"	1597
Lime	1597	"	1650
Slate	1650	"	1690
Sand	1690	"	1708
Lime	1708	"	1740
Slate	1740	"	1810
Berea Grit? (Gantz)	1810	"	1820
Lime shells	1820	"	1880
Slate	1880	"	1915
Fifty-foot Sand	1915	"	1970
Slate	1970	"	1985
Sand ("Thirty-foot")	1985	"	2070
Red rock	2070	"	2073
Sand ("Stray")	2073	"	2110
Slate	2110	"	2115
Sand (Gordon)	2115	"	2160
Red rock	2160	"	2180
Lime shells	2180	"	2210
Red rock, slate and shells	2210	"	2300
Sand (Fourth)	2300	"	2320
Slate	2320	"	2355
Sand (Fifth; gas, 2360')	2355	"	2370
Slate and shell	2370	"	2430
Bayard Sand	2430	"	2470
Gas (small gas)			2435
Oil (two-barrel)			2462
Total depth			2523

Casing record—Ten-inch, 196 feet; 8-inch, 940 feet; 6⅝-inch, 1575 feet.

N. M. Talbott Well, No. 1.

Two miles north of Clarksburg, and 1000 feet east of R. W. Coon Well, No. 1. Authority, Thomas D. Shaffer.

	Feet.		Feet.
Cow Run Sand	415	to	500
Salt Sand	765	"	850
Big Lime	1420	"	1480

Big Injun Sand	1480	"	1585
Gantz Sand	1940	"	1970
Stray Sand	2095	"	2130
Gordon Sand	2130	"	2165
Bayard Sand	2450	"	2491
Show of oil	2480	"	2490
Gas	2452	and	2480
Total depth			2517

"Medium gas well."

Dick Smith Well, No. 1.

Simpson Creek, three miles from mouth. Authority, Thomas D. Shaffer, Superintendent Mandell Oil and Gas Company. Pittsburg Coal 40 feet above derrick floor.

	Feet.		Feet.
Coal (Bakerstown)	346	to	352
First Cow Run Sand	360	"	380
Dunkard Sand	498	"	530
Coal (Lower Freeport)	607	"	614
Gas Sand	665	"	707
Salt Sand	745	"	935
Red rock	1115	"	1312
Red rock	1355	"	1361
Big Lime	1361	"	1435
Big Injun Sand (gas, 1448′ and 1530′)	1435	"	1540
Sand	1551	"	1610
Sand	1790	"	1860
Sand	1910	"	1960
Sand	1972	"	2080
Gordon Sand (gas, 2142′)	2120	"	2145
Fourth Sand	2296	"	2341
Fifth Sand	2363	"	2370
Bayard Sand (show of oil, 2442′ and 2450′)	2434	"	2457
Total depth			2502

Dry hole.

Silas Ogden Well, No. 1.

One mile east of Gypsy. Authority, Thomas D. Shaffer, Superintendent Mandell Oil and Gas Company.

	Feet.		Feet.
Pittsburg Coal	115	to	120
Cave	270	"	310
First Cow Run Sand	450	"	490
Dunkard Sand	615	"	680
Salt Sand (gas, 890′; water, 895′)	740	"	895
Red rock	1210	"	1400
Maxton Sand	1400	"	1410

Lime	1490	"	1555
Big Injun Sand (gas, 1570 to 1580′)	1555	"	1665
Fifty-foot Sand	2057	"	2186
Red rock	2238	"	2243
Gordon Sand	2243	"	2270
Bayard Sand (oil show, 2545 to 2585′)	2544	"	2588
Total depth			2697

"Three million-foot gas well in Big Injun Sand."

The sand at 2424 feet below the Pittsburg coal in this well and the others drilled by the Mandell Company has been identified with the Fifth Sand of the Wolf Summit region which is there 2300 feet to 2320 feet below the Pittsburg coal. It is possible that this may be the correct interpretation, but the writer has called it the Bayard Sand in these records.

J. M. Hall Well, No. 1.

One mile east of Benson, Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Native Coal (Waynesburg)	200	to	204
Pittsburg Coal	605	"	610
Dunkard Sand	1140	"	1190
Gas Sand	1305	"	1309
Salt Sand	1410	"	1770
Red rock	1820	"	1970
Big Lime	2040	"	2095
Big Injun Sand	2095	"	2220
Sand	2395	"	2405
Stray Sand (gas, 2670′)	2640	"	2690
Gordon Sand (gas, 2715′)	2700	"	2740
Fifth Sand and oil	2904	"	2908
Total depth			2922

(Small well.)

John Dillon Well, No. 1.

One mile east of Benson, Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	460		
Little Dunkard Sand	890	to	950
Big Dunkard Sand	960	"	1020
Gas Sand	1290	"	1325
Big Lime	1920	"	1970
Big Injun Sand	1975	"	2100
Stray Sand	2519	"	2565
Gordon Sand	2575	"	2615

Fifth Sand (oil)	2764	"	2776
Total depth			2777

(Ten-barrel pumper.)

Rightmire Well, No. 1.

Mineral Postoffice, Union district. Authority, Southern Oil Company and Mr. Fred S. Rich.

	Feet.		Feet.
Pittsburg Coal	258		
Big Dunkard Sand	750		
Gas Sand	925	to	1210
Little Lime	1670	"	1682
Big Lime	1683	"	1735
Big Injun Sand	1735	"	1845
Gantz Sand	2045	"	2060
Gordon Stray	2325	"	2335
Gordon Sand	2355	"	2380
Fifth Sand (oil in top)	2561	"	2567
Total depth			2590

Rightmire Well, No. 5.

	Feet.		Feet.
Pittsburg Coal	420		
Little Dunkard	820	to	855
Big Dunkard Sand	1204	"	1271
Salt Sand	1445	"	1560
Maxton Sand	1620	"	1635
Little Lime	1830	"	1850
Pencil cave	1850	"	1865
Big Lime	1865	"	1935
Big Injun Sand	1935	"	2070
Gantz Sand	2240	"	2255
Gordon Stray (strong gas, 2450')	2440	"	2530
Gordon Sand	2534	"	2587
Fifth Sand	2728	"	2736
Total depth			2754

"Five million-foot gas well in Gordon Stray."

Rightmire Well, No. 6.

	Feet.		Feet.
Pittsburg Coal	214	to	222
Little Dunkard Sand	725	"	740
Big Dunkard Sand	825	"	990
Salt Sand	1018	"	1324
Little Lime	1605	"	1620
Pencil cave	1620	"	1640
Big Lime	1640	"	1700
Big Injun Sand	1700	"	1805
Gantz Sand	2025	"	2050
Fifty-foot Sand	2188	"	2210

Gordon Stray	2225	"	2305
Gordon Sand (gas)	2315	"	2360
Fifth Sand (oil)	2520	"	2526
Total depth			2534

Rightmire Well, No. 9.

	Feet.		Feet.
Pittsburg Coal, bottom	510		
Elk Lick Coal	710	to	722
Little Dunkard Sand	1040	"	1065
Big Dunkard Sand	1135	"	1300
Salt Sand	1335	"	1640
Little Lime	1900	"	1915
Big Lime	1974	"	2034
Big Injun Sand	2034	"	2130
Berea?	2340	"	2365
Fifty-foot Sand	2518		
Gordon Stray, bottom			2594
Gordon Sand	2594	"	2638
Fifth Sand	2810	"	2816
Total depth			2830

C. C. Tallman Well, No. 1.

Three and one-half miles up Kinchloe Creek, Union district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Big Dunkard Sand	575	to	635
Salt Sand	840	"	975
Big Lime	1465	"	1545
Big Injun Sand	1545	"	1635
Berea	1810	"	1835
Fifty-foot Sand (gas, 1985′)	1965	"	1990
Stray Sand	2015	"	2090
Gordon Sand (gas, 2120′)	2100	"	2135
Fifth Sand (gas, 2315′)	2310	"	2320
Total depth			2385

This well starts near the level of the Pittsburg coal.

The largest gas well in the state, at the present time, is on the farm of Jacob McConkey near Good Hope, Union district. The derrick floor is about 170 feet below the Pittsburg coal. The well was drilled by the South Penn Oil Company, but is now owned by the Hope Natural Gas Company, of which Glen T. Braden is President, and who gave the Survey the following record and data concerning this remarkable well:

Jacob McConkey Well, No. 1.

	Feet.		Feet.
Slate, lime and coal (Bakerstown)	243	to	249
Sand, Dunkard	300	"	380
Sand (Maxton) (water, 1170′)	1165	"	1280
Big Lime	1295	"	1332
Big Injun Sand	1332	"	1375
Sand (Fifty-foot)	1754	"	1800
Stray Sand (light gas)	1836		
Gordon Sand	1865	"	1875
Fourth Sand	1988	"	2030
Fifth Sand (very heavy gas at top)	2160		
Total depth			2160

"Rock pressure, 985 pounds."

Open gate capacity, 26,000,000 feet.

Casing—Ten-inch, 197 feet; 8¼-inch, 924 feet; 6⅝-inch, 1401 feet.

This well is in the range of the general uplift of the Wolf Summit anticlinal which elevates the Pittsburg coal into the tops of the hills, and creates ideal conditions for the occurrence of large gas wells, since it and the great Chestnut ridge arch appear to approach and merge into one broad dome-like structure as the latter dies down to moderate proportions, thus creating ideal conditions for large gas wells in the region of Harrison and Lewis counties where is probably the greatest gas field ever discovered.

Enoch Gaston Well, No. 1.

Between West Milford and Lost Creek Postoffices, Grant district. Authority, Southern Oil Company and Mr. Fred S. Rich.

	Feet.		Feet.
Coal (Bakerstown)	212		
Sand (Gas)	545	to	610
Sand (Salt)	620	"	750
Little Lime	1220		
Pencil cave	None		
Big Lime	1285	"	1340
Big Injun Sand	1340	"	1410
Gantz Sand	1700	"	1780
Red rock	1944	"	1954
Gordon Sand	2015	"	2030
Fourth Sand	2045	"	2075
Fifth Sand	2180	"	2185
Bayard Sand (little gas, show oil)	2215	"	2225

This well begins about 170 feet below the Pittsburg coal.

G. W. Wolf Well, No. 1.

West Milford. Authority, United States Oil Company.

	Feet.		Feet.
Pittsburg Coal	72	to	75
Coal	164	"	170
Red rock and white sand	170	"	200
Lime and white slate	200	"	300
White sand	300	"	360
Slate	360	"	400
Sand	400	"	450
Red lime	450	"	500
Slate	500	"	600
Lime	600	"	675
Coal	675	"	678
Lime	678	"	700
Slate	700	"	800
Slate	800	"	825
Sand, white (water, 880′)	825	"	900
Slate, black	900	"	950
Sand, dark	950	"	1000
Sand	1000	"	1100
Red rock	1100	"	1200
Sand, white	1200	"	1300
Lime and Sand (Big Injun)	1300	"	1500
Slate	1500	"	1600
Shells, black	1600	"	1800
"Gas Sand"	1800	"	1830
White sand (gas)	1830	"	1900
Shells	1900	"	2000
Sand	2000	"	2025
Red rock	2025	"	2100
Sand (Stray)	2100	"	2169
Slate	2169	"	2200
Slate	2169	"	2200
Slate to Gordon Sand (show)	2200	"	2300
Slate	2300	"	2400
Fifth Sand	2460		

Stephen Myers Well, No. 1.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	728	to	735
Dunkard Sand	1200	"	1230
Salt Sand	1400	"	1750
Maxton Sand	2050	"	2065
Big Lime	2100	"	2170
Big Injun Sand	2170	"	2280
Berea Grit (Gantz?)	2500	"	2526

Gordon Sand (gas, 2786′)	2785	"	2792
Oil			2787

A. D. Lawson Well, No. 6.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	478	to	483
Big Dunkard Sand	1050	"	1095
Maxton Sand	1750	"	1830
Big Lime	1840	"	1900
Fifty-foot Sand	2365	"	2395
Stray Sand	2472	"	2500
Gordon Sand (gas, 2595′)	2585	"	2625
Fifth Sand	2784	"	2794
Total depth			2824

A. Mathey Well, No. 3.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	487	to	492
Dunkard Sand	1020	"	1080
Salt Sand	1468	"	1500
Maxton Sand	1742	"	1845
Big Lime	1854	"	1910
Big Injun Sand	1915	"	2018
Stray Sand	2470	"	2565
Gordon Sand	2575	"	2610
Fifth Sand	2790	"	2795
Total depth			2814

A. Mathey Well, No. 6.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	740	to	746
Little Dunkard Sand	1165	"	1225
Big Dunkard Sand	1245	"	1325
Maxton Sand	2035	"	2055
Big Injun Sand	2225	"	2280
Fifty-foot Sand	2705	"	2711
Stray Sand (oil, 2815′)	2802	"	2820

A. Coffindaffer Well, No. 2.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	685	to	690
Big Dunkard Sand	1310	"	1360
Maxton Sand	1960	"	2060
Big Lime	2060	"	2138
Big Injun Sand	2142	"	2200
Fifty-foot Sand	2585	"	2600

Stray Sand	2700	"	2785
Gordon Sand	2795	"	2835
Fifth Sand	2997	"	3003

A. Coffindaffer Well, No. 3.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	458	to	463
Dunkard Sand	948	"	975
Salt Sand	1445	"	1465
Maxton Sand	1754	"	1830
Big Lime	1835	"	1895
Big Injun Sand	1900	"	2000
Fifty-foot Sand	2345	"	2410
Stray Sand	2458	"	2508
Gordon Sand	2550	"	2595
Fifth Sand (oil)	2778	"	2783

F. M. Bailey Well, No. 1.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	645	to	652
Little Dunkard Sand	1100	"	1125
Big Dunkard Sand	1250	"	1300
Big Lime	2030		
Fifty-foot Sand	2595	"	2610
Gordon Sand	2720	"	2755
Fifth Sand	2938	"	2944
Total depth			3018

Jemima Bailey Well, No. 1.

Union District. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	620	to	626
Gas Sand (water, 1430′)	1415	"	1442
Little Lime	2000	"	2010
Big Lime	2040	"	2100
Big Injun Sand	2100	"	2200
Berea	2420	"	2432
Fifty-foot Sand (gas, 2523′)	2520	"	2530
Stray Sand	2596	"	2615
Gordon Sand (oil, 2688′)	2651	"	2704
Gas			2740
Total depth			2977

TAYLOR COUNTY WELL RECORDS.

Taylor county lies east from Harrison and directly south from Marion. The Chestnut anticlinal enters the county

from Southeastern Marion one-half mile below Valley Falls, and passing southwestward through the northwest corner of Taylor near Meadland Postoffice, and Patton Knob enters Harrison, crossing the B. & O. near Oral, three miles east of Bridgeport. This arch is rapidly dying down in altitude southwestward, but it is still so great that the fissures opened down through the strata by its great fold, has probably permitted the escape of nearly all the natural gas and oil that may once have existed in the underlying sand rocks of Taylor, since although some gas and oil occur in every well drilled yet neither has been found in commercial quantity.

The following well records will exhibit the succession through the Venango Oil Sand series in Taylor county.

Hugh Evans Well, No. 1.

Near Pruntytown. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Friendsville?)	105		
Coal (Bakerstown)	315	to	333
Coal (Arden)	560	"	570
Salt Sand	891		
Big Injun Sand	1333	"	1454
Sand (Stray? Little gas)	1914	"	1964
Fourth Sand	2116	"	2140
Fifth Sand	2206	"	2211
Red sand	2211	"	2266
Sandy Lime	2300	"	2340
Sand (Bayard? Elizabeth?)	2380	"	2385
Slate and shells to bottom	2385	"	2680

The horizon of the Pittsburg coal is about 200 feet above the derrick floor, and hence the well passed through the Venango series from 1914 to 2211, since the stratum which held a "little gas" is most probably the representative of the Gordon "Stray".

R. L. Reed Well, No. 1.

Booth Creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Gravel	1	to	25
Sand	25	"	75
Red rock and lime	75	"	200
Sand	200	"	250
Black slate	250	"	330
Sand	330	"	400

Slate	400	"	435
Coal (Upper Freeport)	435	"	440
Slate and shells	440	"	550
Sand	550	"	610
Slate	610	"	630
Sand	630	"	650
Slate	650	"	675
Sand (Salt Sand)	675	"	750
Slate and lime	750	"	975
Red rock	975	"	1130
Lime	1130	"	1280
Red sand	1280	"	1285
Big Injun Sand	1285	"	1413
Slate	1413	"	1418
Sand (Squaw)	1418	"	1430
Red rock	1430	"	1440
Slate	1440	"	1780
Fifty-foot? Sand (light gas, 1798')	1780	"	1825
Slate	1825	"	1845
Sand	1845	"	1875
Slate and shells	1875	"	1935
Red rock and shells	1935	"	2060
Black slate	2060	"	2162
Fifth Sand (red)	2162	"	2185
Black slate	2185	"	2197
Slate and shells	2197	"	2220
Slate	2220	"	2310
Slate and shells	2310	"	2330
Slate	2330	"	2400

Well Two Miles North of Flemington.

Authority, Thomas D. Shaffer, Superintendent Mandell Oil & Gas Company.

	Feet.		Feet.
Coal (Friendsville)	110	to	114
Coal (Bakerstown)	254	"	260
First Cow Run Sand	260	"	270
Second Cow Run Sand	307	"	420
Coal (Upper Freeport)	425	"	432
Sand (water, 514')	509	"	540
Coal (Arden)	546	"	551
Sand	564	"	585
Coal	585	"	589
Sand	600	"	630
Coal	895	"	899
Red rock	900	"	1108
Maxton Sand	1108	"	1120
Big Lime	1265	"	1350

Big Injun Sand (little gas, 1367′ and 1420 to 1436′)	1360	"	1448
Sand (Gantz)	1712	"	1727
Sand	1783	"	1890
Fifth Sand (little gas)	2128	"	2135
Total depth			2400
(Dry hole.)			

Since the well starts 165 feet under the Pittsburg coal, the sand in which a little gas was found at 2128 to 2135 is possibly the representative of the *Fifth Oil Sand* of Harrison county. The driller has given the name Second Cow Run Sand to a stratum which belongs at least 350 feet above the true horizon of that stratum.

The Flemington Coal Company had a test well drilled near the mines of that company, one mile above Flemington, and the following record of the well was furnished by Mr. James F. Haymond of the Flemington Company.

Flemington Coal Co.'s Well, No. 1.

	Thickness Feet.	Depth Feet.
Conductor	13	13
Sand	15	28
Slate	25	53
Limestone	20	73
Red rock	59	132
Limestone	15	147
Slate, light	20	167
Limestone	20	187
Red rock	30	217
Limestone (cased 13′)	20	237
Limestone	10	247
Sand, white	40	287
Slate, black	13	300
Coal (Friendsville)	8	308
Slate, white	5	313
Limestone	7	320
Slate, white	16	336
Limestone	10	346
Slate, white	20	366
Sand	25	391
Slate, black	10	401
Red rock	35	436
Slate, white	30	466
Limestone	6	472

Slate, pink	52	524
Slate, white	18	542
Sand, white (Mahoning)	62	604
Limestone	15	619
Slate	35	654
Limestone	50	704
Sand	41	745
Limestone	6	751
Sand, white	24	775
Sand, black	30	805
Sand, white	35	840
Slate, black	10	850
Sand, white (Salt Sand, top Pottsville)	30	880
Slate	30	910
Sand	72	982
Slate, white (cased, 10″)	12	994
Sand, white	39	1033
Sand, white	40	1073
Slate, black	50	1123
Limestone, black	12	1135
Sand, white (base Pottsville)	23	1158
Slate	6	1164
Red rock	141	1305
Limestone, sandy	24	1329
Red rock	128	1457
Limestone	6	1463
Red rock	10	1473
Limestone	10	1483
Slate	10	1493
Limestone (Big Lime)	35	1528
Limestone	47	1575
Sand (Big Injun; gas)	40	1615
Red rock	10	1625
Sand	30	1655
Red rock	15	1670
Sand	40	1710
Slate and shells	60	1770
Sand, broken and shelly	100	1870
Slate and shells	110	1980
Fifty-foot Sand	115	2095
Slate	10	2105
Sand	20	2125
Red rock	15	2140
Sand (Thirty-foot)	30	2170
Red rock	54	2224
Sand (Gordon)	6	2230
Red rock and shells	150	2380
Slate and shells	55	2435

Sand (Fifth?) (Bayard)	25	2460
Slate	15	2475
Sand and limestone	25	2500
Red rock and shells	50	2550
Limestone and sand	20	2570
Slate and shells to bottom	449½	3019½

This well begins only a few feet below the horizon of the Pittsburg coal and hence the measurements given are of much stratigraphic value. All of the Sands appear to be badly "split up" with slate, shales, etc. A little gas was found in the Big Injun Sand, but even that great *Sand* horizon has largely disappeared into Limestone, red shales, etc.

PRESTON COUNTY WELL RECORDS.

Preston county lies east from Taylor and Monongalia, and extending north to the Pennsylvania line and east to Maryland, on the summit of the Alleghanies.

Only two deep wells have been drilled in the county. One of these was near Bretz. It began near the Upper Freeport coal, and is reported to have been drilled to a depth of 2,000 feet. No record of it could be obtained, but neither gas nor oil was found.

Mr. J. M. Guffey drilled a well at Newburg, near the B. & O. R. R., of which the following record was received from the late Prof. John F. Carll:

Newburg Well.

Authority, Prof. John F. Carll.

	Thickness, Feet.	Depth, Feet.
Sandstone, gray	62	80
Slate and shells, black	50	130
Sandstone, white	40	170
Slate in place of coal **(Upper Freeport)**	20	190
Slate, white and black	120	310
Sandstone, hard and firm, Lower Freeport)	30	340
Slate, white	20	360
Coal, Lower Kittanning	10	370
Slate, white (10″ casing, 385′)	15	385
Sandstone, gray, very hard	50	435
Slate, soft	40	475
Sandstone, gray	35	510
Slate	10	520
Sandstone, gray, very hard (Pottsville)	80	600

Slate (8″ casing, 616′)	15	615
Sandstone, gray	30	645
Slate and shale	55	700
Sandstone, gray (base Pottsville)	20	720
Slate and shale	30	750
Red rock	100	850
Slate and shale	30	880
Lime, white	40	920
Red rock	120	1040
Slate and shale	25	1065
Red rock	10	1075
Slate and shale	35	1110
Lime, dark (Big)	60	1170
Slate, black	5	1175
Sandstone, gray (Big Injun)	118	1293
Slate	10	1303
Red sandstone (6⅝″ casing, 1317′)	20	1323
Slate and shale	20	1343
Sandstone, gray	137	1480
Slate and shale	90	1570
Sandstone, gray	20	1590
Slate, soft	10	1600
Lime	15	1615
Slate and shale	10	1625
Sandstone, gray (Gantz?)	15	1640
Slate	10	1650
Sandstone, gray (50-foot?)	10	1660
Slate and shale	195	1855
Red rock	180	2035
Slate and shale	10	2045
Red rock	256	2301
Slate and shale	49	2350
Sandstone, gray	30	2380
Slate and shale	624	3004

The well starts close to the level of a shaft which goes down through the Upper Freeport and Lower Kittanning coals, while the Pittsburg bed caps the summits of the hills 475 feet above the derrick floor. This gives an interval of (1175′ + 475′) = 1650 feet from the latter coal to the top of the Big Injun Sand, or 300′ to 350′ more than the average in Marion and Monongalia, thus showing the eastward incease in thickness of the sediments, largely those (Mauch Chunk) intervening between the base of the Pottsville and the top of the Mountain (''Big'') Limestone. The *Catskill beds* also exhibit the same tendency to thicken eastward,

as shown by the beds struck at 1855′ and 2045′, respectively. These are the *reds* which occur just under the *"Fifty-foot" oil sand,* over such a wide area in both Pennsylvania and West Virginia, and whose eastward thickening may have some connection with the disappearance of petroleum from the Venango series, in the midst of which they occur. Owing to this great thickening of the measures, it is impossible to make any close correlation of the lowest *Sand* found in the well at 2,350 feet,. about 2,800 feet below the Pittsburg coal, but it would represent one of the deep oil producing sands of the State.

BARBOUR COUNTY WELL RECORDS.

Barbour county lies directly south from Preston and Taylor, and east from Harrison. It thus extends into the mountainous region of the State at its eastern border where the rocks rise sharply (10° to 20°) along the "foot hills" of the Alleghanies, and hence no oil or gas could be expected in paying quantity at any reasonable depth. However several test wells have been bored within the county, since in all a "showing" of both oil and gas was found when the drill was piercing the *Venango Oil Sand Group.* About three wells have been drilled in the vicinity of Philippi, largely by the financial aid of local parties, among whom were Hon. A. G. Dayton, Charles F. Teter and others. One of these wells starts on top of the Mahoning sandstone, and its elevation was determined from accurate levels made by Mr. C. McC. Lemley, who also obtained a copy of the record from the owners of the well, as follows:

Philippi Well, No. 2.

Tolberts Run near Philippi. Drilled for the Tygarts Valley Mineral and Oil Company. Well mouth 1414 feet above tide.

	Feet.		Feet.
Soil	0	to	5
Iron ore, limestone, very hard	5	"	10
Hard sand	10	"	40
Blue tough slate rock	40	"	100
Coal, Upper Freeport	100	"	102
Fine sand or limestone	109	"	121
Slate	121	"	180
Coal	180	"	183

Slate rock	183	"	193
Fine hard sand	193	"	208
Coal (Roaring creek, Arden)	208	"	212
Slate rock	212	"	232
Hard, close sand (Roaring creek)	232	"	277
Coal	277	"	284
Hard sand (cased 10″ at 301′)	284	"	314
Slate	314	"	354
Hard sand	354	"	414
Slate	414	"	419
Dark lime	419	"	434
Slate	434	"	444
Hard sand, more water	444	"	469
Slate	469	"	474
Lime, very hard	474	"	482
Slate	482	"	582
Hard sand	582	"	632
Slate and shell	632	"	672
Hard sand	672	"	692
Hard lime (cased dry 8″ at 700′)	692	"	710
Slate rock	710	"	720
Hard, close sand	720	"	734
Bright red rock	734	"	774
Limestone, very hard	774	"	779
Red rock	779	"	824
Hard sand	824	"	864
Sandy slate	864	"	879
Hard, dark sand	879	"	924
Red shale	924	"	989
Black shale	989	"	1029
Hard limestone (Big)	1029	"	1121
Gray, hard Sand (Big Injun, top)	1121	"	1156
Red sand	1156	"	1181
Hard, gray sand	1181	"	1199
Hard rock	1199	"	1206
Hard, black lime	1206	"	1231
Close Sand (to bottom of Big Injun)	1231	"	1256
Shale	1256	"	1286
Pale red rock	1286	"	1316
Shale	1316	"	1376
White sand (Berea?) fresh water, some oil	1376	"	1420
Hard sand and limestone	1420	"	1500
Hard, dark sand (6¼″ casing at 1635′)	1500	"	1635
Dark red sand and shales	1635	"	1935
Dark gray Sand (Gordon)	1935	"	1970
Slate, with limestone shells	1970	"	2675
Sand, chocolate color	2675	"	2725

"From 2725 no solid formation of any thickness. In one place

shells and shales were found. Quit drilling at a depth of 3,348 feet.''

A flood of comparatively fresh water was found in the coarse white sand at 1376 feet or 1876 feet below the Pittsburg coal, and with it was a show of oil, which comes up with the flowing (artesian) water, and forms an oily scum arond the derrick. This ''show of oil'' gave some hope for better results farther to the west away from the large anticlinal which passes east from Philippi, and with a view to a more thorough test, the Elk Creek Oil and Gas Company put down a well in 1902 about four miles west from Philippi on the head waters of Elk Creek. The record of this well was very carefully kept for Mr. Lemley since he was connected with the oil company. He determined the tide elevation of the well which starts just under the Crinoidal limestone, and 310 feet below the Pittsburg coal. This record reads as follows:

Hall Farm Well.

Elevation derrick floor, 1,047.8′ above tide. Authority, C. McC. Lemley, Assistant Engineer, B. & O. R. R.

	Feet.		Feet.
Soft sand (surface)	0	to	14
Coal (Friendsville)	14	''	20
Lime, black	20	''	35
Lime shell	35	''	55
Lime, red and black	55	''	75
Red rock and slate	75	''	90
Light slate and lime	90	''	100
Sand	100	''	125
Red rock and sand shell	125	''	138
Slate, black	138	''	200
Lime, blue	200	''	275
Sand, white (Mahoning)	275	''	280
Sand, black	280	''	290
Coal **(Upper Freeport)**	290	''	295
Sand, black	295	''	310
Sand, white	310	''	320
Lime, black	320	''	335
Lime, black, sandy	335	''	390
Little Dunkard Sand	390	''	400
Coal (Philippi)	400	''	403
Lime and sand	403	''	418
Slate, white	418	''	448
Slate, black **(Roaring Creek Coal?)**	448	''	453
Slate, white	453	''	458

Sand, white (Roaring Creek)	458	"	510
Slate, white	510	"	535
Lime, white	535	"	545
Coal	545	"	550
Sand, black	550	"	565
Coal	565	"	570
Sand, white, pebbly at base	570	"	626
Shale, brown	626	"	650
Coal	650	"	652
Slate, white	652	"	670
Coal	670	"	672
Slate, white	672	"	685
Sand, dark	685	"	725
Slate, black	725	"	760
Coal	760	"	763
Shale, brown	763	"	786
Lime, black	786	"	806
Sand, white	806	"	831
Slate, black	831	"	841
Sand, white (base of Pottsville)	841	"	896
Slate, black	896	"	926
Lime, white	926	"	931
Slate, black	931	"	941
Red rock and lime	941	"	951
Lime, white	951	"	991
Red rock and lime	991	"	1041
Pebble sand (Maxton)	1041	"	1127
Sand, gray (Maxton)	1127	"	1171
Sand and lime	1171	"	1181
Red rock	1181	"	1196
Slate, black	1196	"	1216
Lime ....35′ Lime, white .... 6′ Lime and slate..... 5′ Lime, black........53′ } Big Lime...	1216	"	1315
Sand and lime (top Big Injun)	1315	"	1325
Lime, white	1325	"	1340
Sand, white	1340	"	1376
Red rock and sand	1376	"	1386
Lime and sand	1386	"	1426
Lime, black	1426	"	1446
Lime, sand	1446	"	1471
Slate, white	1471	"	1511
Lime and sand shale	1511	"	1531
Slate	1531	"	1536
Sand and lime	1536	"	1586
Slate	1586	"	1601
Berea? Sand (Gantz)	1601	"	1631

Lime, black	1631	"	1656
Sand, white (50-Foot)	1656	"	1721
Slate, black	1721	"	1730
Sand	1730	"	1750
Lime, black	1750	"	1799
Slate	1799	"	1879
Red rock	1879	"	1978
Lime	1978	"	1989
Chocolate (red) shale	1989	"	2089
Sand, white (Gordon?)	2089	"	2114
Slate, black	2114	"	2169
Sand, hard	2169	"	2194
Slate, lime and shale to bottom	2194	"	2594

The red beds struck at 1879 feet in this well correspond to those found at 1635 feet in the Philippi boring, since the Hall well begins about 200 feet higher in the measures than the former.

The record of a well drilled farther down Elk Creek in Barbour was given the Survey by Mr. Perry Thompson of Fairmont, W. Va. The well was drilled by the Constant Oil Company, and the record is as follows:

Cole Farm Well, No. 1.

Well started 100 feet below Pittsburg coal.

	Feet.		Feet.
Unrecorded to			400
Dunkard Sand	90	to	490
Unrecorded to			1000
Salt Sand	50	"	1050
Limestone shells	...	"	....
Unrecorded to			1250
Sand (Maxton)	60	"	1310
Big Lime	75	"	1385
Sand (Big Injun)	120	"	1505
Unrecorded to			1800
Gantz Sand	10	"	1810
Slate and shells	40	"	1850
Fifty-foot Sand to bottom	65	"	1915

UPSHUR COUNTY WELL RECORDS.

Upshur county lies directly south from Barbour, and is therefore in the same range of anticlinal folds and proximity to orogenic disturbance as the latter. Hence no oil pools have yet been developed within the borders of Upshur, although a few test wells

have been drilled.

One test was made on the Rose farm a short distance northeast from Buckhannon, and its record is as follows:

Rose Farm Well, No. 1.

Authority, W. H. Nicholson.

	Thickness, Feet.	Depth, Feet.
Clay	8	8
Quick sand	5	13
White slate	12	25
Gray lime	20	45
White slate	10	55
Gray lime	10	65
Black slate	20	85
Red rock	20	105
White slate	10	115
Sand with water (Morgantown?)	15	130
White slate	55	185
Coal	1	186
Black slate	5	191
Gray lime, water	15	206
Black slate	15	221
White lime	30	251
Red rock	6	257
White slate	9	266
Gray sand, water	15	281
White slate	20	301
Sand	35	336
White slate	15	351
Gray lime (Upper Cambridge?)	15	366
Red rock	20	386
White slate	10	396
Sand	45	441
Black slate (Bakerstown coal?)	10	451
Gray lime	13	464
Sand (Mahoning)	72	536
Lime (probably fireclay)	30	566
Sand (Upper Mahoning)	15	581
Black slate	10	591
Black lime	20	611
White slate	55	666
Sand (Lower Mahoning)	15	681
Coal and slate, gas, Roaring Creek (Arden)	15	696
Gray lime	10	706
Lime	50	756
Black slate	39	795

Coal and slate		10	805
Salt Sand (little gas)		118	923
Black slate		10	933
Gray lime		15	948
Slate and shells		120	1068
Sand		12	1080
Slate and shells		75	1155
Lime		6	1161
Slate		29	1190
Lime		20	1210
Sand (gas)		8	1218
Slate		5	1223
Sand		17	1240
Slate		35	1275
Sand, base of Salt Sand (Pottsville)		15	1290
Slate		15	1305
Red rock		35	1340
Lime		20	1360
Sand		30	1390
Lime		40	1430
Slate		15	1445
Red rock		40	1485
Black slate and shells		30	1515
White lime (Big)		65	1580
Brown lime, with black lubricating oil..50′			
White lime........25′			
Black sand ....20′	Big Injun..	180	1760
Red rock .... 5′			
White sand ....80′			
White lime		20	1780
Slate, black and soft		5	1785
White sand, hard		25	1810
Black slate		3	1813
Sand, white, hard		30	1843
Slate, black, soft		5	1848
White sand		12	1860
Hard, black sand		80	1940
Soft black slate		45	1985
Red rock		3	1988
Soft, dark gray sand..40′			
Soft white sand.......17′	Gantz		
Slate shells...........25′	and	107	2095
Hard gray sand.......18′	50-Foot		
Soft white sand ...... 7′			
Slate		10	2105
Red sand		107	2212
Hard gray sand		25	2237

Black slate	23	2260
Hard gray sand	15	2275
Red rock and shells	15	2290
Slate	25	2315
Good white sand	20	2335
Brown sand and red sand	50	2385
Black slate	15	2400
White slate	97	2497

Some oil and gas "shows" were found at several horizons in this well, but nothing in commercial quantity. The Big Injun Sand appears to have been struck at 1580 feet where it has become quite limy and held some dark heavy oil. The Pittsburg coal probably belongs about 100 feet above the level of the derrick floor.

George Burner Well, No. 1.

Near the West Virginia and Pittsburg R. R. Station, Sago. Authority, D. F. Bailey, Manager of the Citizens' Natural Gas Company. Derrick floor about 1435 feet above tide.

	Feet.		Feet.
Soil	0	to	16
Lime, white	16	"	22
Slate or shale, black	22	"	37
Lime, white	37	"	41
Coal and slate	41	"	50
Lime, white	50	"	100
Sand, white	100	"	117
Lime, brown	117	"	121
Sand and lime, white and hard	121	"	190
Slate, black	190	"	207
Slate and sand, black	207	"	244
Lime, white	244	"	255
Slate, black, hard	255	"	371
Sand, white, fine	371	"	391
Lime, white	391	"	400
Sand, white, fine and hard	400	"	476
Slate, black	476	"	587
Lime, brown and hard	587	"	697
Slate, black	697	"	712
Coal and slate	712	"	716
Slate, black	716	"	726
Sand, white, base Pottsville	726	"	800
Red shale, light	800	"	840
Lime, hard and white	840	"	924
Sand, white and hard	924	"	955
Shale, red	955	"	1023

Slate, black, hard	1023	"	1031
Lime, white	1031	"	1046
Shale, black, hard	1046	"	1054
Lime, whitish	1054	"	1078
Shale, red	1078	"	1098
Big Lime, white, hard	1098	"	1190
Sand, white, hard. 22′ Sand, red, light... 12′ Sand, white ......136′ } Big Injun..	1190	"	1360
Slate, black, sandy	1360	"	1374
Sand, white	1374	"	1410
Slate, light	1410	"	1430
Sand, white	1430	"	1510
Lime, white	1510	"	1520
Red rock	1520	"	1684
Sand	1684	"	1703
Red rock	1703	"	1744
Slate	1744	"	1770
Sand and shale (water)	1770	"	1795
Red rock	1795	"	1825
Sand	1825	"	1834
Slate, black	1834	"	1866
Lime, white	1866	"	1878
Slate	1878	"	1884
Lime, white	1884	"	1900
Slate	1900	"	1927
Sand, stray, light (little gas)	1927	"	1933
Slate	1933	"	1940
Slate, sandy, light	1940	"	1965
Slate	1965	"	1980
Sand	1980	"	2000
Slate, black	2000	"	2025

Bottom of well measured with steel line.

"In five foot slaty sand a showing of gas was visible, and a small quantity is yet flowing around the plug. Probably enough to supply a dozen fires. In the Big Injun Sand (1190 to 1360) a showing of something resembling asphalt was found."

This well begins about fifteen feet below the Roaring Creek Coal, and 175 feet below the Upper Freeport seam which here underlies the Pittsburg coal bed by about 700 feet, thus giving an interval of 1890 feet between the latter stratum and the Big Injun Sand, the horizon of which is so unmistakable in the record. The well begins on the immediate top of the great Roaring Creek Sandstone which forms the line of immense pebbly cliffs

from this point to the head of the Buckhannon river, and which Mr. David White of the United States Geological Survey correlates with the top of the Pottsville formation. The thick asphaltic-like oil found in the Big Injun Sand is evidence that the strata are so fissured in this eastern region close to the mountain uplifts, that practically all of the volatile hydro-carbons have escaped. The little gas still imprisoned in these beds was struck at 1927 feet and is in the *Venango series.*

It is possible that the western portion of Upshur may hold oil and gas in commercial quantity when tested still further.

LEWIS COUNTY WELL RECORDS.

Lewis county lies directly west from Upshur and south from Harrison, and hence is far enough removed from the *great* anticlinals which traverse Preston, Barbour and Upshur to lie within the zone of low arches, and gentle dips so that its strata have remained unfractured and its hydrocarbons still imprisoned, except as they have been extravagantly wasted by man's negligence. Several of the largest wells in the state have each been permitted to blow 10 to 20 millions of cubic feet of natural gas into the air daily from Lewis county, for months at a time, before their owners could be induced to shut them in and prevent this frightful waste. Such inexcusable methods in operating for oil and gas call loudly for effective legislative action in order to preserve for productive purposes the great wealth of gaseous fuel with which Lewis and adjoining counties have been dowered.

The effect of structure upon the presence of oil and gas in commercial quantity is finely illustrated in Lewis county. In Monongalia, Marion, Taylor and Harrison no gas or oil pools have been found east of the Chestnut Ridge anticlinal, or even very close to its western slopes. But this arch which is so great in Fayette county, Pennsylvania, (immediately north from Monongalia) that it brings the Hamilton beds of the Devonian into the top of the mountain with dips of 25° to 30° rapidly flattens down southwestward, so that at the Cheat river in Monongalia, it elevates the Gantz Sand only to water level, while at the Valley river where its crest passes into Taylor county near Valley Falls,

only the upper half of the Pottsville formation is brought to the surface. This flattening of the Chestnut Ridge arch continues southwestward through Harrison county, and when the swell reaches the West Fork river in Lewis county, at the old Jackson Mill, three miles below Weston, only the top of the Mahoning sandstone rises to the surface on its crest, and then for the first time we find prolific oil and gas fields passing over and east of this well marked structural zone.

This approach of the productive oil and gas pools to and across this anticlinal, *pari passu,* with its decline, and the disappearance of sharp folding over its crest, lends much force to the conclusion that structure is a prime factor in the accumulation, as well as the preservation of natural gas and petroleum in commercial quantities.

The first well to obtain oil in Lewis county was one drilled in 1894 by the South Penn Oil Compnay on the farm of John Rastle, near the head of Fink creek, not far from the Doddridge county line. The well was small, as was also others drilled near it, so that not much development took place in the county until several years later when a well on the Camden farm, Polk creek, four miles west from Weston, was drilled into the Big Injun Sand by Mr. Fred S. Rich and the Southern Oil Company. This well when deep in the sand struck a rich pocket of oil, and began to flow at the rate of 500 barrels daily. It declined rapidly to a few barrels daily, and no other large wells were found in the region. It served the purpose, however, of attracting the attention of the oil fraternity to Lewis county, and soon led to the drilling of test wells in other portions of the county, as well as in the immediate vicinity of Weston, so that many large gas wells and some good oil pools were soon thereafter developed. The first large gas well in Lewis county was drilled by the Federal Oil Company on the Woodford farm, two miles below Weston, and one mile above where the Chestnut Ridge arch crosses the West Fork river. The record of this well reads as follows:

Woodford Well, No. 1.

Authority, Federal Oil Company.	Feet.	Feet.
Conductor		16

Coal	135	to	141
Coal	380	"	388
Sand (gas and water)	400	"	480
Lime and hard slate	560		
Sand, hard, bottom Salt Sand	780	"	960
Slate and lime	960	"	1000
Red rock	1000	"	1010
Slate	1010	"	1100
Shells, hard	1100	"	1130
Red and black slate	1130		
Hard lime	1290		
Big Lime	1320	"	1370
Keener Sand	1370	"	1380
Big Injun Sand	1380	"	1460
Slate and shells	1680		
Gantz Sand (little gas)	1680	"	1700
Slate and shells	1700	"	1790
Fifty-foot Sand	1790	"	1805
Gordon Sand	1880	"	1900
Red rock	1930	"	1935
Sand and little gas	2000		
Sand	2036	"	2056
Slate	2056	"	2127
Fifth Sand (gas)	2127	"	2142

"Good gas well from "Fifth" Sand."

The following partial record of the gas well which supplies fuel to the Hospital for the Insane at Weston has been given the Survey by Dr. A. H. Kunst, the Superintendent. The well starts about 20 feet below an opening in the Pittsburg coal on the Asylum farm and its record is as follows:

Weston Asylum Well, No. 1.

Authority, Hatzel and Wilson, Contractors.

	Feet.	Feet.
Gray sand	940	
Slate	950	
Lime	965	
Slate and shells	1085	
Lime	1095	
Salt Sand (show of oil)	1244	
Black slate	1274	
Lime	1299	
White slate	1339	
Red rock	1442	
Sand	1462	
Red rock	1542	
Dark sand	1570	

Little Lime	1605		
Pencil cave	1615		
Big Lime	1680		
Big Injun Sand (show of oil)	1843		
Slate	1883		
Sand	1945		
Slate and shells	2051		
Gas Sand (Gantz)	2066	to	2086
Slate to bottom	2112		

This gas sand here would appear to be identical with the oil sand in the Fink pool along the northwestern line of Lewis.

The following is the record of the Camden well already refered to, the coming in of which created so much interest in Lewis county's oil possibilities:

S. D. Camden Well, No. 1.

About four miles from Weston, Freemans creek district. Authority, Fred S. Rich.

	Feet.		Feet.
Conductor	16		
Rock	8	to	24
Blue sand and lime	16	"	40
Red rock	25	"	65
Lime and slate	30	"	95
Red rock	35	"	130
Slate	35	"	165
Lime	10	"	175
Sand (water at 180′)	25	"	200
Coal (Bakerstown)	5	"	205
Slate	25	"	230
Lime and sand (water and gas at 300′)	70	"	300
Break (slate)	5	"	305
Sand	45	"	350
Slate	20	"	370
Sand	80	"	450
Black slate	20	"	470
Sand	130	"	600
Black shale	30	"	630
Sand (water at 650′)	40	"	670
Cave, black	80	"	750
Sand	40	"	790
Slate	30	"	820
Lime	20	"	804
Slate	45	"	885
Sand (strong gas, 1030 to 1050′)	165	"	1050
Break (slate)	15	"	1065
Sand (base of Pottsville)	85	"	1150

Red rock	20	"	1170
Sand (Maxton? Oil, 10 to 15-barrel well)	38	"	1208
Slate	22	"	1230
Red rock	20	"	1250
Sand	50	"	1300
Big Lime	110	"	1410
Sand and lime	10	"	1420
White lime	50	"	1470
Quit in lime at 1483′; Sand (oil)	13	"	1483
Fifth Sand (Bayard?)	2240	"	2262
Total depth of well			2262

"Estimated production from 1483 feet, about 3000 barrels. After oil was exhausted, the well was drilled to the Fifth Sand and a test taken in April, 1902, showed a volume of 2,800,000 feet of gas."

The Pittsburg coal occurs in the hills here about 200 feet above the derrick floor and this in connection with the record of the well shows that the pocket of oil really occurs near the bottom of the Big Injun Sand, although it has become quite limy in this region. Whether the sand with oil at 1,170 represents the *Maxton* horizon, or the one at 1,250, is uncertain, but more probably the former.

The same parties drilled a well at Camden Postoffice, beginning 20 feet above the Pittsburg coal. This record is an important one, and reads as follows:

D. Casto Well, No. 1.

Near Camden Postoffice. Authority, Southern Oil Company and Mr. Rich.

	Feet.		Feet.
Pittsburg Coal	20		
Little Lime	1500		
Big Lime	1520	to	1675
Big Injun Sand	1675	"	1755
Gordon Sand (gas, 2226 to 2232′)	2212	"	2292
Fifth Sand (Bayard?)	2451	"	2455

Did 8,000,000 feet from Gordon while drilling through.

This record shows that the interval from the Pittsburg coal to what the drillers regard as the Big Injun Sand has thickened to 1,655 feet, and that the sand called the *Fifth* in the Weston region lies 2,431 feet below the Pittsburg coal, or about the horizon

of the Bayard Sand of Marion, Monongalia and Greene (Pa.) counties. It is possible that the thickening up of the measures shown by the "Big Lime" would make this great *gas sand* of the Weston region the same as the *Fifth Oil Sand* of Harrison county.

J. B. Lovett Well, No. 1.

Freemansburg Postoffice, five miles northwest of Weston, Freemans creek district. Authority, Southern Oil Company and Fred S. Rich.

	Feet.		Feet.
Big Dunkard Sand	780		
Big Lime	1235		
Big Injun Sand	1318	to	1420
Gantz Sand	1808	"	1860
Gordon Stray	1870	"	1880
Gordon Sand	1900	"	1950
Fifth Sand (gas)	2100	"	2115
Total depth			2130

William Winans Well, No. 1.

Freemansburg Postoffice, Freemans creek district. Authority, Southen Oil Company and Fred S. Rich.

	Feet.		Feet.
Redstone Coal	150		
Pittsburg Coal	180		
Maxton? Sand	1475	to	1490
Little Lime	1670	"	1680
Pencil cave	1680	"	1690
Big Lime	1690	"	1800
Big Injun Sand	1800	"	1900
Gordon Sand	2315	"	2395
Fifth Sand	2536	"	2558
Total depth			2558

"Brown sand and pebble top of Fifth Sand, sand close, hard and glassy."

The sand which the driller has called the "Maxton" in this record is evidently a portion of the Salt Sand (Pottsville) nearly 100 feet above the one doubtfully referred to the Maxton horizon in the S. D. Camden well. This record also shows the presence of the *Redstone coal* above the Pittsburg, a frequent occurrence in Lewis, Harrison and Barbour counties.

A well drilled on the J. S. Norris farm, in northwestern Lewis, although not the deepest in the county. shows the highest

"rock pressure" of any well in the State at the present time, according to Glen T. Braden, President of the Hope Natural Gas Company, who gave the Survey the following record of the well:

J. S. Norris Well, No. 1.

	Feet.		Feet.
Little Dunkard Sand	340	to	390
Big Dunkard	None		
Salt Sand	750	"	830
Big Lime	1300	"	1370
Big Injun Sand	1370	"	1460
Gantz Sand (gas)	1630	"	1675

Casing, 10-inch, 327 feet; $8\frac{1}{2}$-inch, 810 feet; $6\frac{5}{8}$-inch, 1408 feet.
"Rock pressure, 1,125 pounds."

This well is an exception to any other ever recorded in West Virginia or Pennsylvania (of which the writer has knowledge), in that it gives a greater rock pressure than can be accounted for by its depth and the weight of a column of salt water calculated at 45 pounds pressure for every 100 feet, which is about the average weight of the briny waters found in oil sands per square inch for each 100 feet of depth. Applying these figures to the Norris well with a depth of say 1,650 feet to the "pay" streak, gives $45 \times 16\frac{1}{2} = 742\frac{1}{2}$ pounds, as the total rock pressure of this well, which could be accounted for if the column of water back of it would just rise to the level of the derrick floor, thus leaving nearly $372\frac{1}{2}$ pounds unaccounted for, or an equivalent of 828 feet in depth. But how do we know that if water had been struck in this well it would not rise in a pipe to this height above the derrick floor? The surface of the ground where the well starts is only about 1,000 feet above tide, and it is possible that the source of the water (if water is the cause of pressure) may be at that elevation, since the *nearest and lowest* point where the stratum in question emerges above water level is in the gap of Valley river through Rich and Big Laurel Mountains below Elkins, and curiously enough the elevation of the water is there 1,825 to 1850 feet A. T. Then, too, this is the same geological horizon which gave the great flow of artesian water at Philippi, Barbour county, at 1,414 A. T., referred to among the Barbour county well records on a preceding

page, and it is possible that if the supply from the Philippi well could be conducted into a closed pipe, it would rise to a height of 400 to 500 feet more before stopping. Hence, it is not altogether certain that the recorded pressure in the J. S. Norris well breaks down entirely the theory that oil and gas well pressures are due to water.

This Norris well is near the southwestward extension of the Wolf Summitt anticlinal, and the Pittsburg coal is approximately 200 feet above the derrick floor. In the northwestern portion of Lewis county and close to the Doddridge county line many small oil wells have been found along the headwaters of Fink creek and its tributaries. The sand is sometimes called the Gantz and sometimes the Fifty-foot by the oil fraternity, and it is possibly identical with the one called "Berea" in Calhoun county. The records which follow will speak for themselves as to its geological horizon:

Theresa Gum Well, No. 2.

Three miles northwest of Churchville, Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	652	to	659
Little Dunkard Sand	1110	"	1175
Big Dunkard Sand	1210	"	1245
Gas Sand	1446	"	1486
Salt Sand	1530	"	1610
Maxton Sand	1860	"	1870
Big Lime	2100	"	2145
Keener Sand	2145	"	2150
Big Injun Sand	2150	"	2275
Gantz Sand (oil, 2470′)	2458	"	2479
Total depth			2481
(Forty-five-barrel well.)			

Theresa Gum Well, No. 3.

Three miles northwest of Churchville. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	687	to	692
Little Dunkard Sand	1120	"	1180
Big Dunkard Sand	1230	"	1245
Gas Sand	1465	"	1500
Salt Sand	1550	"	1630

Maxton Sand	1880	"	1890
Little Lime	2030	"	2090
Big Lime	2110	"	2180
Big Injun Sand	2190	"	2260
Gantz Sand (oil, 2516′)	2504	"	2529
Total depth			2531

Grant Gum Well, No. 2.

Two miles south of Coldwater, Freemans creek district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Big Dunkard Sand	1015	to	1020
Salt Sand	1350	"	1475
Maxton Sand	1675	"	1690
Big Lime	1920	"	1985
Big Injun Sand	1985	"	2053
Gantz Sand (oil, 2308′)	2296	"	2316
(Thirty-barrel well.)			

Pat Walsh Well, No. 3.

Two and one-half miles south of Coldwater, Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	670	to	677
Little Dunkard Sand	1010	"	1175
Big Dunkard Sand	1210	"	1245
Gas Sand	1450	"	1475
Salt Sand	1540	"	1600
Maxton Sand	1875	"	1880
Little Lime	2050	"	2075
Pencil cave	2103	"	2110
Big Lime	2110	"	2160
Keener Sand	2160	"	2165
Big Injun Sand	2165	"	2290
Gantz Sand (oil, 2491′)	2481	"	2504
Total depth			2506
(Fifty-barrel well.)			

M. A. Fahey Well, No. 3.

Two miles south of Coldwater, Freemans creek district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Coal, Pittsburg	542	to	547
Dunkard Sand	975	"	1045
Salt Sand	1390	"	1411
Maxton Sand	1715	"	1745
Little Lime	1860	"	1890
Big Lime	1955	"	2006

Big Injun Sand	2006	"	2140
Gantz Sand (oil, 2353′)	2344	"	2370
Total depth			2371

Michael Fahey Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	760	to	765
Dunkard Sand	1290	"	1365
Salt Sand	1785	"	1850
Big Lime	2160	"	2220
Big Injun Sand	2220	"	2380
Gantz Sand	2543	"	2562

Patrick Faherty Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	695	to	700
Dunkard Sand	1220	"	1300
Salt Sand	1775	"	1850
Big Lime	2120	"	2175
Big Injun Sand	2180	"	2335
Gantz Sand	2490	"	2510
Thirty-foot	2700	"	2720
Gordon Sand	2800	"	2815
Fifth Sand	3027	"	3033

A. F. Gooden Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	336	to	340
Big Dunkard Sand	850	"	890
Gas Sand	1100	"	1150
Salt Sand	1220	"	1340
Keener Sand	1875	"	1895
Big Injun Sand	1895	"	2050
Gantz Sand	2190		

C. K. Gibson Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	570	to	578
Cave	980		
Little Dunkard Sand	1065	"	1090
Big Dunkard Sand	1130	"	1175
Salt Sand	1505	"	1880
Red rock	1976		
Big Lime	2040	"	2085
Big Injun Sand	2085	"	2190

Gantz Sand (gas, 2438′)	2437		
Total depth			2452

Mary E. Hall Well, No. 2.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	300	to	308
Dunkard Sand	900	"	950
Gas Sand	1210	"	1280
Maxton Sand	1420	"	1430
Big Injun Sand	1800	"	1920
Gantz Sand (oil, 2155′)	2145	"	2175
Total depth			2177

W. H. Hurst Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	554	to	560
Big Dunkard Sand	1100	"	1145
Gas Sand	1360	"	1380
Salt Sand	1480	"	1550
Maxton Sand	1725	"	1740
Big Injun Sand	2040	"	2150
Gantz Sand	2404	"	2420

Emma Jones Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	575	to	581
Big Dunkard Sand	1000	"	1050
Salt Sand	1550	"	1650
Maxton Sand	1700	"	1750
Big Lime	1975	"	2050
Big Injun Sand	2080	"	2180
Gantz Sand (oil, 2423′)	2422	"	2447
Total depth			2490

Timothy Joyce Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
First Coal (Washington)	82	to	85
Pittsburg Coal	650	"	657
Salt Sand	1361	"	1440
Big Lime	2040	"	2120
Big Injun Sand	2120	"	2200
Gantz Sand (oil, 2451′)	2451	"	2471
Total depth			2474

Joseph Krenn Well, No. 3.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Washington Coal	150	to	155
Dunkard Sand	1260	"	1320
Salt Sand	1650	"	1675
Big Injun Sand	2205	"	2330
Gantz Sand	2572	"	2596
Gordon Sand	2893	"	2897
Fifth Sand	3023		
Total depth			3058

S. P. Leggett Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	224	to	230
Little Dunkard	680	"	720
Big Dunkard	765	"	825
Gas Sand	1100	"	1113
Salt Sand	1118	"	1134
Little Lime	1658	"	1673
Pencil cave	1673	"	1683
Big Lime	1700	"	1715
Big Injun Sand	1715	"	1860
Gantz Sand	2104	"	2124
Gordon Sand	2414	"	2421
Total depth			2680

M. J. Lovett Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	240	to	245
Dunkard Sand	780	"	825
Salt Sand	1105	"	1135
Big Lime	1677	"	1735
Big Injun Sand	1735	"	1835
Gantz Sand	2102	"	2110
Slate to bottom	2110	"	2690

J. R. Lowther Well, No. 2.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	535	to	542
Salt Sand	1450	"	1550
Big Lime	1940	"	2000
Big Injun Sand	2000	"	2060
Gantz Sand (oil, 2390′)	2380	"	2400
Total depth			2410

M. C. Marsh Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	445	to	451
Big Dunkard	900	"	925
Gas Sand	1225	"	1290
Salt Sand	1325	"	1355
Maxton? Sand	1570	"	1600
Pencil cave	1895	"	1905
Big Lime	1905	"	1955
Big Injun Sand	1955	"	2075
Gantz Sand (gas, 2312′)	2299	"	2319

Maxwell Heirs' Well, No. 9.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	545	to	550
Dunkard Sand	1115	"	1200
Salt Sand	1450	"	1525
Maxton Sand	1700	"	1780
Big Lime	2000	"	2050
Big Injun Sand	2050	"	2180
Gantz Sand (gas, 2376 to 2386′)	2375	"	2392
Slate to bottom	2392	"	2395

Leopold Stadler Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	450	to	455
Big Dunkard Sand	965	"	985
Gas Sand	1245	"	1290
Salt Sand	1300	"	1350
Little Lime	1820	"	1970
Big Lime	1880	"	1950
Big Injun Sand	1950	"	2070
Gantz Sand (oil, 2290′)	2285	"	2311
Total depth			2316

J. C. Starcher Well, No. 2.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	656	to	662
Big Dunkard Sand	1150	"	1175
Gas Sand	1310	"	1410
Salt Sand	1535	"	1685
Keener Sand	1965	"	1985
Big Injun Sand	2010	"	2110
Gantz Sand (oil, 2511′)	2501	"	2535

Mary Albers Well, No. 1.

Lewis and Doddridge counties, Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	306	to	313
Little Dunkard Sand	775	"	800
Big Dunkard Sand	825	"	850
Gas Sand	1060	"	1070
Salt Sand	1155	"	1200
Sand	1422	"	1447
Sand	1500	"	1520
Little Lime	1673	"	1708
Pencil cave	1708	"	1714
Big Lime (gas, 1730′)	1738	"	1802
Big Injun Sand	1808	"	1906
Gantz Sand (oil)	2154	"	2180
Total depth			2185

Mary Albers Well, No. 2.

Freemans creek district, Lewis and Doddridge counties. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	551	to	556
Little Dunkard Sand	1005	"	1050
Big Dunkard Sand	1070	"	1205
Salt Sand	1415	"	1455
Maxton? Sand	1550	"	1630
Pencil cave	1995	"	2000
Big Lime	2025	"	2060
Big Injun Sand	2060	"	2180
Gantz Sand (oil, 2410′; water, 2415′)	2405	"	2430

G. A. Brown Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	655	to	660
Big Dunkard Sand	1090	"	1155
Salt Sand	1520	"	1615
Big Lime	2108	"	2150
Big Injun Sand (show oil, 2154′)	2150	"	2300
Gantz Sand	2468	"	2490
Stray Sand	2680	"	2695
Gordon Sand	2780	"	2794
Fifth Sand	2975	"	2976
Total depth			3088

Dennis Conroy Well, No. 4.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	450	to	455
Dunkard Sand	960	"	1000
Big Lime	1850	"	1925
Keener Sand	1925	"	1950
Big Injun Sand	1950	"	2000
Gantz Sand (oil, 2290')	2280	"	2300

John Casey Well, No. 1.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Dunkard Sand	425	to	480
Gas Sand	590	"	640
Salt Sand	790	"	930
Sand	1230	"	1260
Maxton Sand (gas, 1422')	1420	"	1440
Little Lime	1440	"	1450
Pencil cave	1450	"	1460
Big Lime	1460	"	1560
Big Injun Sand	1560	"	1670
Stray Sand	2195	"	2224
Gordon Sand	2224	"	2236
Fifth Sand (gas, 2410')	2410	"	2435

Cottrill Heirs' Well, No. 1.

Mineral Postoffice, Freemans creek district. Authority, Southern Oil Company and Fred S. Rich.

	Feet.		Feet.
Pittsburg Coal	176		
Little Lime	1610		
Big Lime	1658		
Big Injun Sand	1700	to	1850
Sand	2060		
Gantz Sand	2005		
Gordon Stray	2200		
Gordon Sand	2276	"	2330
Fifth Sand (gas, 2515')	2498	"	2612

John Leyden Well, No. 2.

Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	610	to	615
Big Dunkard Sand	1110	"	1170
Salt Sand	1675	"	1735
Big Lime	2045	"	2105

Big Injun Sand	2105	"	2260
Gantz Sand	2412	"	2430
Thirty-foot Sand	2620	"	2650
Gordon Sand	2725	"	2735
Fifth Sand	2915	"	2920
Total depth			3010

Brent Maxwell Well, No. 3.

Two miles west of Benson, Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Washington)	251		
Coal (Waynesburg?)	525	to	535
Pittsburg Coal	819	"	924
Little Dunkard Sand	1250	"	1303
Big Dunkard Sand	1335	"	1365
Gas Sand	1500	"	1665
Maxton Sand	2125	"	2155
Little Lime	2180	"	2195
Big Lime	2227	"	2280
Big Injun Sand	2290	"	2346
Gas at 2309′ and 2315′.			
(Gas well.)			

Ellen Joyce Well, No. 1.

Two miles east of south of Coldwater, Freemans creek district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	820	to	826
Dunkard Sand	1340	"	1380
Salt Sand	1620	"	1710
Maxton Sand	2020	"	2040
Big Lime	2250	"	2325
Big Injun Sand	2325	"	2405
Gantz Sand (gas, 2625 to 2631′)	2619	"	2637
Total depth			2640

One of the most remarkable oil wells the State has ever produced was drilled by the South Penn Oil Company in 1900, on the land of John Copley, about ten miles southwest from Weston. As the venture was a test or "wild cat" well, many miles from pipe line connections no provision had been made for taking care of any large production. But when the drill entered the "pay" streak in what was called the "Gordon" Sand the oil immediately began to flow, and the well "drilling itself in"

increased its flow to what was estimated at 6,000 barrels daily, thus making it the largest well ever struck in the State. The oil went down Sand Fork creek (which was low at the time) in a great flood and many thousands of barrels were wasted before the prdouction declined or could be controlled. Much oil was saved by damming Sand Fork creek. The production of the well rapidly declined, however, and no other well approaching it in size was found in the region, although many wells of good size were drilled.

The record of the John Copley well reads as follows:

John Copley Well, No. 1.

Sand Fork region. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	250		
Dunkard Sand	850	to	910
Salt Sand	1040	"	1400
Pencil cave	1895	"	1920
Big Injun Sand	1975	"	2200
Stray Sand	2609	"	2620
Gordon Sand	2629	"	2645

The coal struck at 250 feet is identified by the drillers with the Pittsburg coal, and if this determination is right (and there is no reason for doubting its correctness) then the depth to the Gordon Sand (2,379 feet) would reveal a considerable thickening of the measures southwestward from Weston.

The following are other records from the Sand Fork oil region:

M. Copley's Heirs' Well, No. 1.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	140		
Pencil cave	1775	to	1800
Big Lime	1800	"	1895
Big Injun Sand	1895	"	2025
Stray Sand	2512	"	2524
Gordon Sand (oil)	2530		

Parr Mullady Well No. 11.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	187		
Big Lime	1785	to	1835

Big Injun Sand	1892	"	2075
Stray Sand	2545	"	2549
Gordon Sand (gas, 2561′)	2556	"	2565
Fifth Sand (oil, 2727′)	2726	"	2732
Total depth			2761

Here we find another productive zone at 170 feet below the top of the Gordon Sand. If the coal of this section and the previous ones should prove to be the *Waynesburg,* instead of the *Pittsburg,* as it is called by the oil fraternity, then the thickness of the measures would be about the same in the Sand Fork region as at Weston.

B. F. Clayton Well, No. 1.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	345	to	348
Dunkard Sand	910	"	1000
Big Injun Sand	2105	"	2400
Stray Sand	2734	"	2742
Gordon Sand (oil, 2759′)	2755	"	2765
Fifth Sand	2929	"	2932

James Murphy Well, No. 2.

One mile and a half southwest of Bealls Mills, Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	580	to	583
Little Dunkard Sand	1015	"	1030
Coal	1105	"	1107
Big Dunkard Sand	1189	"	1234
Salt Sand	1840	"	1905
Big Lime	2200	"	2280
Big Injun Sand (little gas, 2400′)	2280	"	2450
Stray Sand (gas and oil, 2887′)	2886	"	2892
Gordon (dry)	2904	"	2910
Fifth Sand (shell) dry	3070		
Total depth	3127		

"Shot with 20 quarts at 2,857 feet. Filled up 50 feet with oil from Stray 24 hours after shot."

I. N. Means Well, No. 1.

One mile and a half southwest of Bealls Mills, Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	525	to	528
Coal	1095	"	1105
Salt Sand	1375	"	1540

Maxton Sand	1925	"	1985
Little Lime	2165	"	2190
Big Lime	2212	"	2280
Big Injun Sand (show oil, 2320′; gas, 2385′)	2288	"	2508
Stray Sand (show oil, 2895′)	2895	"	2901
Gordon Sand	2913	"	2920
Fifth Sand	3075	"	3078
Total depth			3097

C. W. McCutcheon Well, No. 6.

One mile southwest of Bealls Mills, Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	515	to	518
Dunkard Sand	1060	"	1090
Salt Sand	1400	"	1560
Maxton Sand	1920	"	2005
Big Lime	2220	"	2319.
Big Injun Sand	2319	"	2470
Stray (oil, 2878′)	2877	"	2885
Gas in Gordon Sand	2899	"	2900
Total depth			2915

Beall Heirs' Well, No. 1.

Bealls Mills Postoffice, Court House district. Authority, Southern Oil Company and Fred S. Rich.

	Feet.		Feet.
Pittsburg Coal	460		
Little Dunkard Sand	700	to	745
Big Dunkard Sand	990	"	1020
Salt Sand	1500	"	1715
Maxton Sand	1730	"	1745
Big Lime	2020	"	2125
Big Injun Sand	2125	"	2245
Red rock	2635		
Gordon Stray	2655	"	2675
Gordon Sand (oil, 2755′)	2745	"	2760
Fifth Sand	2940	"	2942
Total depth			2956

J. C. Collins Well, No. 1.

Near Bealls Mills Postoffice, Court House district. Authority, Fred S. Rich.

	Feet.		Feet.
Pittsburg Coal	530		
Big Dunkard Sand	1010	to	1070
Salt Sand	1110	"	1190

Little Lime	2110	"	2125
Pencil cave	2125	"	2140
Big Lime	2140	"	2250
Big Injun Sand	2250	"	2400
Gordon Stray	2794	"	2811
Gordon Sand	2826	"	2835
Fifth Sand	3010	"	3017
Total depth			3032
(Dry hole.)			

J. C. Collins Well, No. 5.

	Feet.		Feet.
Pittsburg Coal	600		
Big Dunkard Sand	1160		
Salt Sand	1465		
Little Lime	2175		
Big Lime	2200		
Big Injun Sand			2440
Gordon Stray	2852	to	2862
Gordon Sand (oil, 2896′)	2888	"	2909

W. S. Kirkpatrick Well, No. 1.

Near Gilmer county line. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Dunkard Sand	830	to	880
Salt Sand	1570	"	1650
Pencil cave	1805	"	1810
Big Lime	1810	"	1900
Big Injun Sand	1900	"	2125
Stray Sand	2445	"	2450
Gordon Sand	2465	"	2469
Fifth Sand (oil, 2681′)	2680	"	2690
Total depth			2723

J. H. Mertz Well, No. 1.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Dunkard Sand	685	to	730
Salt Sand	940	"	1010
Big Injun Sand	1760	"	1930
Stray Sand	2366	"	2376
Gordon Sand	2406	"	2421
Fifth Sand (gas, 2584′)	2582	"	2590
Total depth			2608

M. M. Sommers Well, No. 7.

Court House district, Sand Fork field. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	445	to	449
Dunkard Sand	1050	"	1110
Pencil cave	2100	"	2110
Big Lime	2110	"	2180
Big Injun Sand	2180	"	2400
Stray Sand	2801	"	2809
Gordon Sand (oil, 2821′)	2819	"	2831
Total depth			2861

W. H. Dent Well, No. 1.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	300		
Dunkard Sand	1050	to	1090
Pencil cave	2080	"	2090
Big Lime	2090	"	2180
Big Injun Sand	2180	"	2400
Stray Sand	2640	"	2646
Gordon Sand	2668	"	2673
Fifth Sand	2838		
Total depth			3052

J. N. Butcher Well, No. 1.

Court House district. Authority, South Penn Oil Company.

	Feet.		Feet.
Big Dunkard Sand	1050	to	1098
Salt Sand	1800	"	1990
Big Lime	2120	"	2200
Big Injun Sand	2200	"	2420
Stray Sand	2780	"	2787
Gordon Sand	2795	"	2798
Fourth Sand	2840	"	2844
No Fifth Sand.			
Total depth			3103

William E. Donlan Well, No. 2.

Court House district. Authority, South Penn Oil Company.

Pittsburg Coal	325	to	329
Dunkard Sand	900	"	950
Pencil cave	2000	"	2010
Big Lime	2010	"	2060
Big Injun Sand	2060	"	2250
Stray Sand	2681	"	2686

"No Gordon or Fifth Sands."

B. Bohen Well, No. 1.

Sixteen miles south of Weston. Authority, United States Oil Company.

	Feet.		Feet.
First Coal	275		
Second Coal	356		
Pittsburg Coal	550		
Big Lime	2275	to	2380
Big Injun (gas, 2450 to 2475′)	2380	"	2480
Slate and shells	2480	"	2800
Gordon Stray (oil, 2907′)	2905	"	2915
Gordon Sand	2930	"	2936

B. Bohen Well, No. 3.

Sixteen miles south of Weston. Authority, United States Oil Company.

	Feet.		Feet.
First Coal	75		
Second Coal (Redstone)	105		
Pittsburg Coal	140		
Little Lime	1765		
Pencil cave	1795	to	1805
Big Lime	1805		
Big Injun Sand (gas, 1920′)	1895	"	2105
Black slate	2105	"	2165
Sand	2165	"	2190
Hard lime	2190	"	2215
White sand	2215	"	2240
Hard lime and "boulders" (nuggets)	2240	"	2250
Slate	2250	"	2270
Hard lime	2270	"	2295
Slate	2295	"	2315
Hard and blue lime	2315	"	2365
Sandy lime	2365	"	2375
Black slate	2375	"	2405
Hard lime	2405	"	2415
Black slate	2415	"	2425
Red rock	2425	"	2435
Lime, shells and slate	2435	"	2460
Black slate	2460	"	2485
Gordon Stray (oil)	2485	"	2495
Slate	2495	"	2505
Gordon Sand	2505	"	2517

This is an important record, since its details show the presence of *red beds* at 530 feet below the top of the Big Injun Sand, at the horizon where they are so often found above the Gordon

Stray in Wetzel, Harrison and Doddridge counties to the west, thus tending to confirm the identification of the "Stray" and Gordon Sands in the Sand Fork pool, notwithstanding their much greater interval below the Pittsburg coal.

A little oil was once found in the "Panhandle" of Lewis county, between Upshur and Braxton. The oil occurs in the bottom of the "Salt Sand" at a depth of 450 to 500 feet, just above the red Mauch Chunk shales, on a tributary of the Little Kanawha river known as Wild Cat. The oil is of light gravity and amber color, but is so mixed up with water that no paying wells have ever been found, although a fine "showing" has been obtained in nearly every one of the dozen or more wells that have been drilled. It appears to be impossible to case off the water without also shutting out the oil.

GILMER COUNTY WELL RECORDS.

Gilmer county lies southwest from the western half of Lewis county, and hence the rock formations found in the Sand Fork region of the latter pass directly into the underground structure of Gilmer. Sand Fork creek flows down the central portion of a great synclinal trough in which the rocks dip to the southwest as well as to the northwest and southeast. This tilted synclinal structure sets in somewhere east from Weston in Lewis county, but does not attain its deepest "sag" until near the Little Kanawha in Gilmer county, near the mouth of Sand Fork creek, where the Pittsburg coal is buried to a depth of more than 100 feet below water level, and to nearly 600 feet above tide. Many of the great gas wells of Lewis and Gilmer occur on the eastern and western slopes of the syncline, as well as around its tilted up northeastern portion, while the oil wells occur at lower levels down the dip from the gas wells. The oil production of Gilmer is practically confined to the extension of the Sand Fork and Fink pools of Lewis, since although some oil has been found in nearly every test well drilled within the county, yet no paying wells have yet been found outside of these two districts, although it is quite possible that other pools will be found when more test wells have been drilled.

The following are records of wells in the Sand Fork pool adjoining Lewis:

W. S. Kirkpatrick Well, No. 4.

Near line of Glenville district, edge of Gilmer county. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg? Coal	210		
Dunkard Sand	770	to	825
Big Lime	1855	"	1970
Big Injun Sand	1970	"	2125
Fifth Sand (oil, 2853′)	2852	"	2858

The coal reported at 210 feet in this record may not be the Pittsburg bed, since a coal is sometimes reported in this region at 70 to 100 feet above the Pittsburg bed.

J. W. Moody Well, No. 1.

Five miles northeast of Sand Fork Postoffice, Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Bakerstown?)	1025	to	1027
Little Dunkard Sand	1080	"	1095
Big Dunkard Sand	1131	"	1222
Gas Sand	1280	"	1328
Salt Sand	1372	"	1850
Maxton Sand	2160	"	2200
Pencil cave	2228	"	2236
Big Lime	2236	"	2306
Big Injun Sand (gas, 2435′)	2306	"	2528
Stray Sand	2934	"	2941
Gordon (shell)	2953		
Fifth Sand	3094	"	3098
Total depth			3218

Amanda B. Connor Well, No. 1.

Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Elk Lick?)	325		
Big Dunkard Sand	650	to	709
Salt Sand	1300	"	1395
Maxton Sand	1515	"	1550
Pencil cave	1585	"	1600
Big Lime	1600	"	1660
Big Injun Sand	1660	"	1990
Gordon Sand (shells)	2410		
Fifth Sand	2622	"	2626
Total depth			2703

W. H. Cox Well, No. 1.

Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Big Dunkard Sand	840	to	900
Pencil cave	1850	"	1860
Big Lime	1860	"	1920
Big Injun Sand	1920	"	2070
Stray Sand	2482	"	2492
Gordon Sand	2507	"	2510
Fifth Sand (oil, 2678′)	2677	"	2683

W. H. Cox Well, No. 2.

Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Elk Lick?)	430		
Dunkard Sand	700	to	740
Salt Sand	1530	"	1600
Maxton Sand	1620	"	1690
Big Lime	1785	"	1800
Big Injun Sand	1800	"	1960
Stray Sand	2450	"	2460
Gordon Sand	2475	"	2482
Fifth Sand (oil, 2674′)	2673	"	2678

W. H. Cox Well, No. 4.

Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal?	200		
Dunkard Sand	880	to	950
Stray Sand	2700	"	2711
Gordon Sand	2730	"	2740
Fifth Sand (oil, 2929′)	2928	"	2933

Marshall Estate Well, No. 3.

Joes run, about two miles northeast of Stouts Mills. Authority, J. M. Guffey.

	Feet.
Coal	240
Little Dunkard	790
Big Dunkard	815
Break	880
Salt Sand (very hard)	890
Maxton Sand	1790
Limestone	1975
"Blue Monday"	2000
Break	2020
Big Lime	2026
Big Injun Sand	2086

Berea Grit?	2230
Red rock	2670
Gordon Sand	2698
Fifth Sand	2864
Total depth	2898

Hudnall Well, No. 1.

On Sliding Hill run, one half mile from mouth, near Stouts Mills. Authority, J. M. Guffey.

	Thickness, Feet.	Depth, Feet.
Gravel	25	25
Limestone	15	40
Red rock	10	50
Limestone	10	60
Red rock	5	65
Slate	27	92
Coal, Pittsburg	9	101
Limestone	29	130
Slate	2	132
Sand	68	200
Red rock	7	207
Slate	5	212
Limestone	33	245
Red rock	10	255
Slate	5	260
Red rock	30	290
Sand	65	355
Slate, break	2	357
Sand, hard	18	375
Slate	5	380
Limestone	5	385
Sand, hard	31	416
Slate	10	426
Coal (Friendsville?)	3	429
Limestone	17	446
Red rock	4	450
Slate	5	455
Red rock	40	495
Limestone	15	510
Slate	10	520
Pink rock	35	555
Limestone	15	570
Sand	20	590
Slate	30	620
Pink rock	20	640
Slate	10	650
Dunkard Sand (Mahoning)	65	715

Limestone	15	730
Sand	65	795
Sand and shell	45	840
Sand	35	875
Coal	5	880
Sand	30	910
Slate, break	2	912
Sand	68	980
Slate	3	983
Sand	24	1007
Slate, break	3	1010
Sand	42	1052
Slate, shell	48	1100
Slate, black	20	1120
Slate and shell	26	1146
Sand and shell	9	1155
Limestone, blue	20	1175
Sand	12	1187
Slate and shell	136	1323
Sand, black	6	1329
Sand, gray	87	1416
Slate, black	112	1528
Sand, white	10	1538
Slate, black	50	1588
Sand, white (base Pottsville)	68	1656
Slate, white	10	1666
Red rock	12	1678
Slate and shell	10	1688
Red rock	10	1698
Limestone, hard	10	1708
Slate and shell	10	1718
Limestone	10	1728
Slate and shell	30	1758
Limestone	12	1770
Limestone, sandy	10	1780
Sand	20	1800
Slate, black	5	1805
Big Lime	60	1865
Keener Sand	10	1875
Limestone, hard	10	1885
Big Injun Sand	105	1990
Slate, break	7	1997
Sand	53	2050
Limestone, sand	30	2080
Slate and shell	70	2150
Slate, black	25	2175
Sand shell	5	2180
Slate, dark	40	2220

Sand, black	20	2240
Slate and shell	165	2405
Red rock	5	2410
Slate and shell	85	2495
Sand, Gordon	7	2502
Slate and shell	83	2585
Red rock	10	2595
Slate and shell	60	2655
Fifth Sand (oil)	12	2667
Bottom		2672

This record is important for the many stratigraphic details it affords.

Heath Well, No. 1.

Butcher Fork of Sand Fork creek, near Lewis county line. Authority, J. M. Guffey.

	Thickness, Feet.	Depth, Feet.
Slate	70	86
Red rock	100	186
Slate	100	286
Sand	60	346
Slate	20	366
Sand	34	400
Red rock	50	450
Slate	60	510
Slate and shells	140	650
Sand (Dunkard)	50	700
Lime	60	760
Sand	150	910
Slate	80	990
Lime	30	1020
Sand, white	150	1170
Lime	50	1220
Sand (Pottsville)	430	1650
Red rock	75	1725
Slate and shells	150	1875
Lime	25	1900
Slate	30	1930
Big Lime	90	2020
Big Injun Sand	200	2220
Slate and shells	275	2495
Sand (Gantz)	20	2515
Slate	35	2550
Red rock	10	2560
Slate	30	2590
Sand (Stray)	15	2605
Shale, white	13	2618

Sand, Gordon	7	2625
Slate	54	2679
Red rock	21	2700
Slate, dark	30	2730
Sand, Fifth	47	2777
Slate, white	3	2780
Total depth		2825

Lynch Well, No. 4.

Joes Crossing. Authority, J. M. Guffey.

	Thickness, Feet.	Depth, Feet.	
Red rock, slate and limestone		715	
Coal?	5	720	
Slate, limestone and red rock?	80	800	
Big Dunkard Sand and slate		1400	
Salt Sand	160		
Maxton Sand	100	1700	
Limestone and slate	180	1880	
Little Lime	22	1902	(?)
Pencil cave	22		(?)
"Blue Monday"	50	1952	
Big Lime	100	2052	
Big Injun Sand	150	2202	
Slate		2237	
Berea Grit	25		
Slate	...	....	
Gordon Sand	3	2625	
Slate	179	2804	
Fifth Sand	8		
Total depth		2830	

This record is very defective, but the measurements to the main sands are probably recorded correctly.

William E. Lively Well, No. 1.

Glenville district. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Dunkard Sand	766	to	776
Salt Sand	860	"	919
Maxton Sand	1835	"	1865
Pencil cave	1960	"	1962
Big Lime	1962	"	2000
Big Injun Sand	2000	"	2100
Gordon Sand	2585		
Fifth Sand	2775		
Total depth			2908

The following are records of wells drilled across the Gilmer

county line in the southwest extension of the Fink creek pool along the edge of Doddridge county:

J. C. Bush Well, No. 1.

Troy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal (Uniontown?)	130	to	131½
Black cave	840		
Salt Sand	1390	"	1520
Sand (Maxton?)	1580	"	1670
Pencil cave	1735		
Big Lime	1780		
Big Injun Sand (gas, 1900′)	1840	"	1920
Gantz Sand (oil, 2238 to 2248′)	2236	"	2271
Bottom			2276

J. C. Bush Well, No. 2.

Troy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Dunkard Sand	850	to	885
Sand	935	"	970
Sand	990	"	1030
Sand	1145	"	1170
Sand	1182	"	1215
Maxton Sand	1460	"	1600
Sand	1670	"	1710
Big Lime	1805	"	1895
Big Injun Sand	1895	"	1940
Gantz Sand (oil, 2266 to 2275′)	2266	"	2280
Total depth			2293

C. B. Bush Well, No. 1.

Troy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Black cave	750		
Sand	795		
Big Dunkard Sand	910	to	940
Slate	950		
Sand	960		
Slate	1000		
Salt Sand	1020		
Slate	1100		
Sand	1150		
Maxton? Sand (gas)	1335	"	1375
Sand	1555		
Little Lime	1660		
Big Lime	1710	"	1770
Big Injun Sand (gas, 1820′)	1770	"	1828

Sand and shells	2110		
Gantz Sand (gas, 2159′)	2154	"	2160
Shells	2525	"	2725
Soft slate to bottom	2725	"	2735

The Gordon and Fifth Sands are indicated only by *Shells* in this well.

L. A. Law Well, No. 1.

Troy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Small show of coal (Pittsburg)	210	to	212
Big Dunkard Sand	960	"	995
Salt Sand	1200	"	1331
Maxton? Sand	1460	"	1540
Big Lime	1800	"	1890
Big Injun Sand (gas, 1910′)	1897	"	1960
Stray Sand	2480	"	2490
Gordon Sand	2495	"	2497
Fifth Sand	2705	"	2715
Depth			2740

Thomas Scott Well, No. 1.

One mile and a half north of Troy Postoffice, on Cove creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	700	to	710
Salt Sand	810	"	866
Salt Sand	970	"	1195
Maxton Sand	1450	"	1460
Big Lime (gas top)	1535	"	1615
Big Injun Sand	1640	"	1680
Berea Sand	2020	"	2035
Total depth			3204
(Dry.)			

South from the Little Kanawha river there have been several large gas wells drilled in the vicinity of Stumptown by the Stumptown Oil & Gas Company. They are clustered along the general line of the Chestnut Ridge anticlinal, and the gas is obtained in the Pottsville, or "Salt Sand," formation of the drillers.

One of these wells shows the following succession, as furnished by Mr. John T. Harris, Secretary of the Company.

No. 3 Well, Stumptown Oil & Gas Co.

	Feet.		Feet.
First Cow Run Sand	485	to	620

Lime and slate	620	"	695
Sand	695	"	710
Lime, shells and slate	710	"	785
Sand	785	"	890
Lime, shells and slate	890	"	1178
Coal	1178	"	1186
Lime	1186	"	1215
"Salt Sand" ("big gas")			1215

Well No. 4, Stumptown Oil & Gas Co.

	Feet.		Feet.
Unrecorded	0	to	140
Red rock, lime and shells	185	"	325
Coal	4	"	329
Red rock, lime and shells	166	"	495
First Cow Run Sand (Mahoning)	120	"	615
Limestone, shells and slate	95	"	710
Sand	18	"	728
Limestone and slate	67	"	795
Sand	113	"	908
Limestone, shells and slate	287	"	1195
Coal	9	"	1204
Limestone	26	"	1230
Sand, gas	...	"	....

The well begins about 100 feet below the Pittsburg coal, and hence the Sand struck at 495 feet and called "First Cow Run Sand" in the record, is most probably the one known as the "Big Dunkard" by the drillers in the Sand Fork region.

The Rush well, No. 1, two miles southwest of Stumptown, drilled by Messrs. Kenny and others, gave the following succession, according to Mr. Harris:

Rush Well, No. 1.

	Feet.		Feet.
Slate and shells	225	to	250
Sand	250	"	275
Lime and slate	275	"	300
Red rock	300	"	400
Sand	400	"	425
Slate	425	"	450
Red rock	450	"	525
Lime	525	"	565
Red rock	565	"	580
Slate and shell	580	"	665
Cow Run Sand, slate and shell	665	"	775
Hard, white lime	775	"	800
Sand	800	"	920

Slate and shells	920	"	940
Sand	940	"	953
Coal	953	"	960
Sand	960	"	1050
Coal	1050	"	1056
Slate and shells	1056	"	1100
Sand	1100	"	1160
Slate and shale	1160	"	1280
Lime	1280	"	1350
Slate and shell	1350	"	1400
Lime	1400	"	1430
Slate and shell	1430	"	1475
Sand (gas, 1480′; oil, 1500′)	1475	"	1521
Slate and shell	1521	"	1540
Sand (oil)	1540	"	1698

The sand struck at 1,540 feet, in which some oil is found, was supposed by the drillers to represent the "Big Injun," but it is probably higher, as would be indicated by the following record of a deep well drilled in the same region by the South Penn Oil Company:

Bennett Well, No. 1.

Bennett farm, just above Stumptown, on Bear Fork of Steer creek. Authority, South Penn Oil Company.

	Thickness, Feet.	Depth, Feet.
Conductor	20	20
Red rock	30	50
Blue sand	35	85
White slate	15	100
Red rock (cased 10-inch, 200′)	100	200
White slate	50	250
Red rock	50	300
White slate	35	335
Green sand	15	350
Red rock	50	400
White slate	65	465
White sand	35	500
White slate	75	575
White sand	110	685
Black slate	10	695
Limestone	10	705
White sand	30	735
White slate	75	810
White sand	20	830
Black slate	13	843
White sand, gas (cased 8¼-inch, 851′)	25	868

White slate	35	903
White sand	40	943
Black slate	57	1000
White sandstone	75	1075
Sand, shells and black slate	205	1280
White sand	55	1335
Black slate	96	1431
White sandstone (Maxton?) (cased 6⅝", 1455')	50	1481
Pencil slate	3	1484
Limestone	11	1495
Sand, hard	14	1509
Sandstone, soft	27	1536
Pebbles	29	1565
Black slate	20	1585
Big Lime, hard	60	1645
White Sand (Keener)	10	1655
Limestone	55	1710
White sandstone (Big Injun)	75	1785
Sand and shells	100	1885
White slate	200	2085
Slate and shells	200	2285
Black slate, hard, sandstone and shells	100	2385
Sand (gas) (Gordon, or Fifth)	2	2387
Slate and shells	163	2550
Slaet, white and soft to bottom	118	2668

The sand struck at 1,280 feet is most probably the one in which the Stumptown Oil & Gas Company obtains its gas.

The first deep well drilled in Gilmer county was sunk on the Fisher farm, one mile west of Tanner Postoffice, in 1891, by parties from Parkersburg. The well begins 40 feet below what is supposed to be the Waynesburg coal (but which may be the Uniontown) and 265 feet below the Washington bed. The record of the well reads as follows, according to Hon. John T. Harris of Parkersburg, who received the same from James Showalter, contractor:

Fisher Well, No. 1.

	Thickness, Feet.	Depth, Feet.
Conductor		8
Unrecorded	36	44
Red shale	11	55
Blue limestone, with red and blue shale and sand shells	77	132

Red rock		46	178
Hard, blue sand		20	198
Red and gray shale		42	240
Red and blue shale with blue sand shells		58	298
Red rock		23	321
Gray sand		14	345
White fire clay		9	354
Red and white shale (cased 7⅝″ at 359′)		68	422
Blue sand		10	432
Red rock		78	510
Limestone and shale, white		26	536
Red rock		24	560
Black sand		15	575
White shale		27	602
Red rock		33	635
White shale		25	660
Red rock with white clay at bottom		10	670
Gray sand, hard, 2′ at top with **1 ft. coal**		3	673
White shale		57	730
Hard, sharp sand		25	755
Dark gray shale (cased 6¼″ at 778′)	Mahoning Dunkard	23	778
Hard, white sandstone, blue at bottom		20	798
Limestone		57	855
White sandstone (Gas Sand)		90	945
White slate		71	1016
Hard, white sandstone		46	1062
Black shale		8	1070
Slate and sand, shale and lime		36	1106
Sandy shale		44	1150
Coal		...	....
Soft shale		25	1175
Sandy shales		70	1245
Fine gray sandstone and limestone		45	1290
White and black shale, with limestone nuggets		106	1396
Sandstone, very hard and white		44	1440
Black and white shale		10	1450
Dark gray sand		30	1480
Shale, with sand and limestone, hard		50	1530
Limestone		20	1550
Shale and limestone (4⅞-inch casing)		70	1620
Sand, hard and limy		55	1675
Big Lime, gas at bottom		65	1740
Sand, white, gas and little oil (Big Injun)		63	1803
Slate, with shells		217	2020
Sand, some oil (Gantz, Berea)		40	2060

Slate, blue	305	2365
Sand (Gordon?)	6	2371
Slate	69	2440
Hard, sandy pebble	1	2441
Slate to bottom	269	2710

BRAXTON COUNTY WELL RECORDS.

Braxton county lies directly southeast from Gilmer, and extends to the mountainous region of the State and hence, so far as present developments have gone, has no oil or gas production of commercial value, except at its most northern point, which approaches near enough to the Sand Fork oil pool to come within the zone of good gas territory. Also, just at the edge of Gilmer and Calhoun counties a little oil was once developed by the South Penn Oil Company, the first well in the base of the "Salt Sand" giving such promise of a paying proposition that a pipe line, 30 odd miles in length was laid to bring the oil to the Sand Fork pump station. But after drilling about 10 wells and only four of them proving productive operations have ceased in the region, and the four are now producing 15 barrels daily.

The following records will show the succession of the rocks in the vicinity of Rosedale, within one to three miles of which all the wells are located on a very large tract of mostly uncultivated land. Some of the wells may be in the edge of Gilmer county:

W. G. Bennett Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Soil and quicksand	34	to	34
Sand	34	"	160
Red rock	160	"	262
Sand	262	"	300
Slate and red rock	300	"	400
Sand and lime	400	"	460
Coal	465	"	472
Sand	505	"	530
Lime	530	"	550
Sand	550	"	560
Sand	577	"	590
Lime	661	"	690
Sand	700	"	730
Sand	900	"	928
Lime	1020	"	1155

Sand	1155	"	1165
Sand	1184	"	1225
Sand, extra hard	1290	"	1415
Coal	1547		
Sand	1560	"	1580
Slate	1580	"	1585
Sand	1585	"	1610

"Oil and gas, 1592 feet; oil, 1600 feet; salt water, 1610 feet."

W. G. Bennett Well, No. 2.

	Feet.		Feet.
Sand	450	to	500
Sand	600	"	640
Sand	780	"	840
Lime	840	"	955
Sand	955	"	1000
Sand (gas, 1040′)	1030	"	1150
Sand	1390	"	1420
Sand	1475	"	1530
Coal	1810	"	1813
Sand (Maxton?)	1876	"	1960
Little Lime	2000	"	2025
Pencil cave	2025	"	2040
Big Lime	2040	"	2125
Big Injun Sand	2125	"	2220
Shells	2220	"	2420
Gantz Sand	2420	"	2435
Fifty-foot Sand	2580	"	2595
Slate, lime and shells	2595	"	3090
Hard lime shells to bottom	3090	"	3275

The Bennett wells all start below the Pittsburg coal by an interval of 100 to 150 feet, and this record exhibits the increasing thickness of the Pottsville beds to the southeast, since the Pittsburg coal—Big Injun Sand interval has here thickened to over 2,200 feet.

W. G. Bennett Well, No. 4.

	Feet.		Feet.
Sand	326	to	340
Slate and shells	340	"	520
Sand	520	"	570
Sand	800	"	940
Sand and lime	1070	"	1272
Sand	1480	"	1510
Sand	1630	"	1648
Maxton Sand	1925	"	1940
Sand and lime	1940	"	1985

W. G. Bennett Well, No. 5.

	Feet.		Feet.
Sand	150	to	250
Sand	300	"	345
Red rock	345	"	350
Sand	645	"	855
Sand	880	"	980
Sand	1180	"	1280
Slate and shells	1280	"	1380
"Gas" Sand (gas, 1485')	1465	"	1500
Lime and shells	1500	"	1535
Black slate	1535	"	1625
Coal	1635	"	1645
Salt Sand (oil rock)	1665	"	1685
Slate and shells to bottom	1685	"	1778

W. G. Bennett Well, No. 6.

	Feet.		Feet.
Sand	438	to	465
Sand	540	"	558
Sand	672	"	712
Sand	780	"	830
Sand	950	"	1154
Sand	1350	"	1380
Sand and lime	1440	"	1727
"Salt Sand" (oil, 1747')	1730	"	1756

W. G. Bennett Well, No. 7.

	Feet.		Feet.
Sand	400	to	450
Slate and red rock	450	"	700
White sand	700	"	760
Sand	800	"	830
White sand	900	"	925
Slate and lime	925	"	1180
Sand	1400	"	1430
Slate and shells	1430	"	1712
Salt Sand (oil rock)	1712		
Bottom			1733

W. G. Bennett Well, No. 8.

	Feet.		Feet.
Coal	980	to	984
Coal	1670	"	1674
Salt Sand (oil rock)	1680	"	1686
Total depth			1740

A bed of coal has been noted in several of the wells (and doubtless occurs in all of them) at a few feet above the oil bearing stratum. This sand is very probably the same as the gas

producing rock at Stumptown, since a coal bed also occurs above it there.

A test well drilled on the Little Kanawha bottoms, just opposite the B. & O. station at Burnsville, gives the following succession, according to Mr. R. M. Zahniser, one of the owners:

Marshall Well, No. 1.

	Thickness, Feet.	Depth, Feet.
Clay, yellow, soft, conductor	11	11
Lime, white, hard	20	31
Sand, white, hard (water)	40	71
Red rock, soft	10	81
Slate, blue, soft	10	91
Red rock, soft (cave)	30	121
Lime, hard	24	145
Slate, red rock and shell (water and cased)	365	510
Sand, white and soft, coarse, with pebbles	40	550
Lime, blue, hard	15	565
Sand, gray	25	590
Slate and shells, white and soft	25	615
Lime, gray, hard	25	640
Slate and shells, white and soft	75	715
Sand, white, hard	115	830
Sand, gray, hard	50	880
Lime, shells and slate	120	1000
Sand, white, hard	50	1050
Slate and shells	70	1120
Lime, white	20	1140
Slate and shells, blue, hard	50	1190
Lime, white, hard	25	1215
Sandstone, white (oil and gas, 1407′)	210	1425
Slate, black, soft	25	1450
Sand, white, hard	40	1490
Lime	50	1540
Red rock, soft	95	1635
Big Lime, gray, hard	40	1675
Sand, Big Injun, gray, white, hard (show oil and gas)	42	1717
Limestone, gray	200	1917
Slate and shells, blue, soft	20	1937
Sand, gray, hard	30	1967
Slate, black, soft	20	1987
Sand (Gantz?), white, hard, (little oil)	5	1992
Slate and shells, blue and soft to bottom	290	2282

The well starts 350 feet or more below the horizon of the Pittsburg coal.

Robinette Well, No. 1.

Oil creek, two miles northeast of Burnsville. Authority, William H. Nicholson, Jr., contractor.

	Feet.		Feet.
Conductor			18
Red rock	18	to	105
Lime	105	"	160
Red rock	160	"	175
Lime	175	"	275
Slate	275	"	300
Coal (Bakerstown?)	300	"	304
Sand	304	"	322
Slate	322	"	350
Lime	350	"	380
Slate	380	"	410
Lime	410	"	430
Sand	430	"	555
Lime	555	"	570
Coal (Upper Kittanning?)	570	"	579
Sand	579	"	596
Slate	596	"	600
Sand	600	"	660
Slate	660	"	665
Sand	665	"	735
Lime	735	"	745
Sand	745	"	855
Lime	860	"	870
Slate	870	"	1080
Sand	1080	"	1130
Slate	1130	"	1180
Sand (1190′)	1180	"	1255
Slate	1255	"	1300
Lime	1300	"	1330
Sand	1330	"	1370
Lime	1370	"	1380
Sand (base Pottsville)	1380	"	1450
Red rock	1450	"	1490
Slate	1490	"	1550
Big Lime	1550	"	1660
Big Injun Sand	1660	"	1800
Slate	1800	"	1910
Lime	1910	"	1935
Slate	1935	"	2120
Lime	2120	"	2148
Stray Sand	2148	"	2166

Slate	2166	"	2170
Gordon Sand (little gas)	2170	"	2185
Slate	2185	"	2200
Sand	2200	"	2206
Slate	2206	"	2310
Fifth Sand (show of oil)	2310	"	2316
Slate	2316	"	2630
Lime	2630	"	2640
Slate	2640	"	2660
Lime	2660	"	2690
Slate and shells to bottom	2690	"	2800

The Pittsburg coal comes 250 to 300 feet above the level of the well.

A. L. Jack Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Quicksand	31	to	45
Dunkard Sand	875	"	940
White sand	1110	"	1130
White sand	1160	"	1264
Maxton Sand	1317	"	1342
Salt Sand	1545	"	1585
Pencil cave	1788	"	1800
Big Lime	1800	"	1850
Big Injun Sand	1850	"	2000
Gordon Sand	2515	"	2520
Sand	2650	"	2665
Total depth			2920

Three or four test wells have also been drilled in Webster county, which lies east from Braxton, and wholly within the mountain region of the State. Nothing but "slight shows" of either oil or gas was obtained, however, in any of them. One of these, drilled by Meade Brothers for the Haddix and Leading Creek Oil & Gas Company on the Vandervort farm, about two miles below Cleveland, gave the following succession, according to Mr. Hague of Tidioute, Pa., one of the parties interested.

Vandervort Well, No. 1.

	Feet.		Feet.
Conductor	35		
Quicksand	25	to	25
White, hard sand	25	"	50
Lime and slate	50	"	125
Sand, hard and poor	125	"	158
Lime	158	"	183

Shale and lime	183	"	272
Sandy lime	272	"	365
White shale	365	"	385
Lime, sandy, shale and red rock	385	"	900
Sand, probably Maxton	900	"	925
Sandy lime	925	"	950
Black shale	950	"	960
Lime, probably "Big Lime"	960	"	1125
Sand (cave, 1200′; salt water, 1225′)	1125	"	1225
Sand and lime (cased 6⅝-inch)	1225	"	1265
Red rock	1265	"	1285
Sandy lime (Big Lime)	1285	"	1500
Gray sand (Big Injun)	1500	"	1550
Sandy shells and slate	1550	"	1600
Lime, shells and slate	1600	"	1700
Sandy lime	1700	"	1750
Lime, shells and slate to bottom	1750	"	1807

CALHOUN COUNTY WELL RECORDS.

Calhoun county lies directly north from Braxton, and west from Gilmer, and hence is within the gentle dipping rocks of the State northwest from the *mountain* region where both oil and gas exist in commercial quantity. The development of these interests got a late start in this county, owing to the dry holes drilled at an early date, but some good pools of oil have now been found, as well as many large gas wells, so that Calhoun's production is rapidly increasing.

The most of the oil produced comes from a sand which the oil fraternity has dubbed the *Berea,* and although details in the Calhoun records are often wanting, there would appear to be but little doubt that this "Berea" Sand is the same one that is called the Gantz in the Fink creek pool of Gilmer, Lewis and Doddridge to the northeast, where it underlies the Pittsburg coal by an interval of 1,840 feet.

The following records from the several regions of the county will speak for themselves:

Metz Well, No. 1.

Fifteen miles south from Cairo, on Leading creek. Authority, Cairo Oil Company.

	Feet.
Gas Sand	1380
Good sand to	1440

Slate to	1460
Salt Sand to	1545
Break, slate	1603
Good Sand	1630
Bottom of sand	1631
Coal	1636
Sand, two feet	1638
Big Lime	1642
Big Injun Sand (gas, 1788'; oil, 1809')	1744
Bottom sand	1812
Slate and shells	1835
Bottom Sand (Big Injun)	1837

James Metz Well, No. 1.

One mile west of Ayers Postoffice. Authority, Lowther Oil Company.

	Feet.
Berea Sand, top	2111
"Pay"	2130
Total depth	2150

One hundred and twenty-five-barrel natural, January, 1901; 15-barrel June, 1904.

James Metz Well, No. 2.

	Feet.
Berea Sand, top	2102
"Pay"	2120
Total depth	2156

Fifty barrels natural October, 1902; 15 to 18 barrels June, 1904.

James Metz Well, No. 4.

	Feet.
Berea Sand, top	2256
"Pay"	2274
Total depth	2289

Seventy-five-barrel well August, 1903; 50-barrel June, 1904.

"Cow Run Sand about 800 to 900 feet; Salt Sand, 1,400 feet."

H. C. Lockney Well, No. 1.

On Bear run. Authority, New York Petroleum Company.

	Feet.		Feet.
Soft shale	410		
First Cow Run Sand	630	to	642
Second Cow Run Sand (Eight-inch casing, 955')	680	"	830
Gas Sand	970	"	1000
Top of shale and blossom of coal	1006		
Black, limy slate, having smell of oil and about 25 feet thick	1275		

Salt Sand (little gas, 1428')	1422	"	1460
Top of Maxton Sand	1524		
Pencil cave	1575		
(Six and one-fourth-inch casing, 1580')			
Top of "Break"	1605		
Top of Big Injun Sand	1615		
Squaw Sand (light show of oil)	1690	"	1704
Bottom of well			1736

Finished in black sand and slate (dry hole).

W. L. Camden Well, No. 1.

Sherman district. Authority, South Penn Oil Company.

	Feet.		Feet.
Red rock	16	to	50
White slate	50	"	75
Blue sand	75	"	125
Red rock	125	"	155
Red rock	180	"	250
Coal	250	"	253
Slate	253	"	298
Red rock	298	"	338
Sand	338	"	398
Red rock and shells	398	"	453
Sand	453	"	470
Red rock and shells	470	"	505
Sand	505	"	545
Slate and shells	545	"	555
Sand	555	"	590
Slate and shells	590	"	620
Coal	620	"	624
Slate and shells	624	"	644
Red rock and shells	644	"	712
Slate	712	"	792
Sand	792	"	820
Lime	820	"	850
Sand	850	"	915
Slate	915	"	927
Sand	927	"	1099
Slate	1099	"	1119
Sand	1119	"	1214
Black slate	1214	"	1378
Sand	1378	"	1418
Black slate	1418	"	1438
Sand (hard)	1438	"	1464
Slate and shells	1464	"	1619
Salt Sand	1619	"	1670
Black slate	1670	"	1680
Red rock	1680	"	1688
Shale	1688	"	1690

Big Lime	1690	"	1808
Big Injun Sand	1808	"	1872
Slate and shells	1872	"	2159
Black slate	2159	"	2194
White slate and shells	2194	"	2480
Pink slate	2480	"	2498
Slate and shells	2498	"	2901

The Venango sands are entirely absent here as Sands, but their place is still marked by the *pink* or *red beds* at 2,480 feet, 672 feet below the top of the Big Injun Sand.

Allen Hardman Well, No. 1.

About three miles west of Grantsville. Authority, Carter Oil Company.

	Feet.		Feet.
No coal.			
Cave	470	to	790
Cow Run Sand	890	"	990
Salt Sand	1340	"	1620
Big Lime	1620	"	1690
Keener Sand	1695	"	1730
Big Injun Sand	1775	"	1795
Berea	2130	"	2138
Gordon Sand (shelly)	2370		
Total depth			2540

Samuel Ayers Well No. 1.

On Spring Fork of Yellow creek, adjoining Metz wells. Authority, J. M. Guffey.

	Feet.		Feet.
Big Lime	85	to	1605
Keener Sand	60	"	1690
Big Injun Sand	30	"	1730
Berea Sand, Gantz?	22	"	2140
Bottom of well			2155

Cornell Well, No. 1.

Authority, Courtney and McDermott. By J. C. Leonard. Completed September 4, 1901.

	Feet.		Feet.
Conductor			16
Salt Sand	200	to	1300
Coal	8	"	1308
Unrecorded	192	"	1500
Salt Sand, (gas 1510′ and 1525′)	60	"	1560
Unrecorded	140	"	1700
Maxton Sand	40	"	1740

Unrecorded	13	"	1753
Little Lime	45	"	1798
Big Lime	92	"	1890
Big Injun Sand	30	"	1920
Lime and sand shells	130	"	2050
Slate	75	"	2125
Black shale and slate	125	"	2250
Gray Sand (Berea) and slate to bottom	84	"	2334

Lewis Hamrick Well, No. 2.

One-half mile north of Rhoda. Authority, Mallory Brothers & Stewart.

	Feet.
Conductor	15
Water	150
Ten-inch casing	276
Top Big Dunkard Sand	974
Eight and one-fourth-inch casing	982
Gas	1510
Little water	1584
Big flow water	1592
Little Lime	1750
Six and five-eighths-inch casing	1752
Top Big Lime	1766
Top Berea Sand	2245
Completed	2273
(Forty-barrel well.)	

L. C. Hamrick Well, No. 3.

One-half mile north of Rhoda. Authority, Mallory Brothers & Stewart.

	Feet.
Conductor	11
Ten-inch casing	363
Eight-inch casing	1176
First flow water	1700
Oil at	1762
Hole full of water	1775
Coal	1866
Maxton Sand	1872
Little Lime	1910
Big Lime	1919
Six and five-eighths-inch casing	1938
Berea Sand, top of	2393
First oil	2409
(Fifty-barrel well.)	

G. W. Taylor Well, No. 5.

Near Rhoda, on Yellow creek, Sheridan district. Authority, Mallory Brothers & Stewart.

	Feet.
Conductor	8
Gas	310
Gas again	340
Water, ten bailers	445
Gas	480
Eight and one-fourth-inch casing	869
Gas	1335
Water	1440
Big flow water	1464
Break	1545
Maxton Sand	1558
Top Big Lime	1629
Six and five-eighths-inch casing	1630
Through Big Lime	1710
Gas	1740
Through Big Injun Sand	1754
Top of Sand (Berea)	2115
First "pay"	2132
Total depth	2150
(Sixty-five-barrel well.)	

G. W. Taylor Well, No. 6.

	Feet.
Conductor	16
Ten-inch casing	277
Gas	380
Eight-inch casing	964
Little gas	1520
Water	1535
Coal	1605
Break of slate	1628
Big Lime	1694
Six and five-eighths-inch casing	1726
Top Big Injun Sand	1778
Gas in Big Injun Sand	1830
Top of Berea Sand	2206
Oil in Berea Sand	2218
Total depth	2238
Shot forty quarts.	
(Fifty-barrel well.)	

The *coal* reported in this and the preceding wells (Metz and Hamrick) so deep down in the measures may possibly be some-

thing akin to Grahamite like that in the vertical fissure near Macfarlan in Ritchie county.

G.W. Taylor Well, No. 9.

At Rhoda Postoffice.

	Feet.
Conductor	11
First casing	416
Water	500
Eight and one-fourth-inch casing	1161
First water	1745
Big flow water	1768
"Break" of coal and slate	1835
Through Maxton Sand	1865
Top of Little Lime	1895
Six and five-eighths-inch casing	1912
Top of Big Lime	1924
Gas in Big Injun	2005
Through Big Injun	2020
Oil and gas (Berea)	2410
Finished	2422

Shot with 60 quarts from 2407 to 2419 feet.
(Fifty-barrel well.)

G. W. Taylor Well, No. 10.

	Feet.
Conductor	12
Showing oil	1440
Water, little	1455
Through Maxton Sand	1660
Through Big Injun Sand	1788
Berea	2151
First "pay" oil	2165
Total depth	2180

About forty barrels per day.

John W. Rogers Well, No. 1.

One-half mile southwest of Rhoda Postoffice. Authority, Mallory Brothers & Stewart.

	Feet.
Top Salt Sand	1435
Gas and little water	1454
Showing of oil	1454
Big flow of water	1515
"Break" of slate	1570
Top of Little Lime	1635
Gas in Keener Sand	1725
Gas in Big Injun Sand	1740

Berea, top of			2125
"Pay"			2143

"Started off at 50 barrels."

Near the western portion of Calhoun, just northeast from Richardson, the Carter Oil Company has discovered a small pool of Berea Sand oil, some records from which have been kindly given the Survey by Mr. W. H. Aspinwall of the Carter Oil Company, Sistersville, W. Va., as follows:

Rebecca Curry Well, No. 1.

One mile northeast of Richardson, Lee district.

	Feet.		Feet.
Cave	600	to	850
Cow Run Sand	935	"	955
Salt Sand	1460	"	1623
Pencil cave	1638	"	1648
Big Lime	1648	"	1810
Berea Sand	2172	"	2203
Bottom			2212

(Twenty-barrel well.)

Rebecca Curry Well, No. 2.

	Feet.		Feet.
Cave	745	to	945
Cow Run Sand	945	"	975
Salt Sand	1520	"	1610
Cave	1660	"	1665
Big Lime	1665	"	1825
Big Injun Sand	1825	"	1840
Berea Sand	2195	"	2222

Rebecca Curry Well, No. 3.

	Feet.		Feet.
Cave	800	to	950
Cow Run Sand	1130	"	1150
Salt Sand	1700	"	1845
Big Lime	1882	"	2032
Big Injun Sand	2032	"	2047
Berea Sand	2370	"	2398
Bottom			2398

Rebecca Curry Well, No. 4.

	Feet.		Feet.
Cow Run Sand	940	to	950
Second Cow Run Sand	1045	"	1060
Gas Sand	1100		
Salt Sand	1306	"	1346
Salt Sand	1570	"	1715
Little Lime	1720	"	1735

Big Lime	1747	"	1826
Big Injun Sand	1826	"	1920
Berea Sand	2295	"	2322

E. M. Board Well, No. 1.

On Big Rowels run, one mile north of Richardson. Authority, W. H. Aspinwall of the Carter Oil Company.

	Feet.		Feet.
Cave	450	to	600
Cow Run Sand	940	"	975
Gas Sand	990	"	1120
Salt Sand	1180	"	1225
Salt Sand	1470	"	1629
Little Lime	1640	"	1650
"Blue Monday"	1665	"	1685
Big Lime	1685	"	1762
Big Injun Sand	1762	"	1840
Berea Sand	2207	"	2223
Gordon (shells)	2390	"	2399
Bottom			2575

E. A. Fore Well, No. 2.

On Big Rowels run, Lee district. Authority, W. H. Aspinwall of the Carter Oil Company.

	Feet.		Feet.
Cave	500	to	700
Cow Run Sand	858	"	868
Second Cow Run Sand	940	"	945
Gas Sand	984	"	1006
Salt Sand	1170	"	1200
Salt Sand	1488	"	1635
Little Lime	1640	"	1665
Big Lime	1673	"	1744
Big Injun Sand	1744	"	1828
Berea Sand	2192	"	2220
Bottom			2221

RITCHIE COUNTY WELL RECORDS.

Ritchie county lies directly north of Calhoun and Gilmer. Being also bounded, east by Doddridge, north by Pleasants and west by Wirt, in all of which many productive oil and gas wells have been found, this county could hardly fail to yield large quantities of each, and the drilling of numerous wells in Ritchie has resulted in the development of many rich pools of both gas and oil.

The great Burning Springs-Volcano Anticlinal passes across the extreme western edge of the county, and as the pioneer oil drillers who first discovered petroleum near the crown of this great "(oil break") arch in the adjoining county of Wirt simply followed the same north to the Ohio river, drilling shallow wells every few hundred feet, they soon arrived in Ritchie, and its oil development began in the early '60's, so that it has been producing more or less oil from drilled wells ever since, and as explained in Chapter I, its commercial oil history had already begun many years previous. The "shallow oil sand" territory along this "oil break" had been pretty well drilled over and exhausted before it finally occurred to the operators to drill deeper for other sands, after the Macksburg developments of 1883 and 1884 had proven the existence of a "paying" sand at several hundred feet below the "Salt Sand" and Big Injun, the then lowest developed oil-bearing beds of Ritchie county. A few paying wells were found in this deeper Sand (Berea), but no serious effort was attempted to test Ritchie county for oil outside of the "oil break" until after the Eureka and Mannington pools had been developed. The first active operations of this later period were in the vicinity of Cairo in 1890, where oil was found in both the "Salt" and Big Injun Sands, and from this region developments for either oil or gas have spread to nearly every portion of the county. The deep, or *Venango group* of Sands appear to have practically vanished as coarse or *reservoir* deposits from every portion of Ritchie, since the Big Injun Sand is the lowest one now producing either gas or oil, and hence the Cow Run (Dunkard), Salt Sand, or Maxton, and the Big Injun (with its top member, the Keener) are now the only productive sands in Ritchie, since the *Carroll Sand* wells, the highest oil producing zone yet developed in West Virginia, and which formerly produced some oil in the vicinity of Cairo at about 200 feet above the Pittsburg coal, are no longer operated. These upper and shallower sands have proved prolific in oil and gas over such a wide area in Ritchie, that it produces a large amount of both, and more than half the county has not yet been fairly tested.

The elevation of the great arch along the western edge of the county has produced a number of parallel disturbances which have extended across its area and created structures favorable for the cumulation of oil and gas in commercial quantity. One effect of this upheaval (whose greatest dips are 20° to 30° on its eastern slope and 50° to 70° on its western side, separated by a broad and nearly level crown a mile or more in width, within which the oil pools occur) was to open up a deep vertical fissure, one to five feet wide at the surface and nearly a mile in length, at right angles to the direction of the flexure. Through this opening much oil escaped until it was finally choked up and tightly plugged by caving walls and the residual products of the oil oxydized into *Grahamite* by chemical changes. This fissure is situated near Macfarlan, not far from the South Fork of Hughes river, and about four miles east from the "oil break," or crest of the Burning Springs anticlinal. The deposit has been fully described by the writer in the Bulletin of the Geological Society of America, Vol. 10, pp. 277 to 284, April 1899, to which the reader is referred for details.

This fissure, as well as the great flexure which gave origin to it, illustrates how the oil and gas have been lost and dissipated from their rock reservoirs in the mountain regions of the State. It also illustrates under what conditions very steeply folded rocks may still hold their original petroliferous deposits imprisoned. The reason why oil yet exists in the rocks along the "oil break" is because the oil-bearing sands there were still covered up when the flexure was made, by a great thickness of soft and plastic red shales, clays, etc., of the Conemaugh and Dunkard series, through which apparently only one fissure extended to the surface, and even it was soon closed, probably at first by the caving of the red shales softened by oil, just as they do now when the drill penetrates them and water is permitted to remain in contact with these soft clays and shales. But in the mountainous regions of the State there exists but a small thickness of these soft "caving" clays and shales, and hence the hard rocks readily fissure from folding, and as such fissures do not close themselves through

caving walls, practically all of the volatile hydro-carbons have escaped from mountain regions, unless, indeed, it may be possible that some are yet imprisoned at very great depths where they are almost or quite below the present limits of practicable drilling operations. The highly folded strata in the oil regions of California, Colorado, Wyoming, etc., and the steeply dipping domes of Louisiana and Texas illustrate the same principle, since the overlying clays and other plastic beds have largely prevented the escape of the precious hydro-carbons. The oil sands of Grosny and Baku, in Russia, covered up by a great thickness of Tertiary clays and marls also confirm the same. But where escape of the liquid and volatile hydro-carbons has taken place we get such oxydized residual products as Asphaltum, Giisonite, Urintaite, Grahamite, Albertite, etc.

This Grahamite of Ritchie county, as explained in Vol. I, was formerly mined and shipped east on an extensive scale for use in the manufacture of gas, since it contains about 60% of volatile combustible matter, but the easily accessible portions were soon exhausted and a disastrous explosion of gas in the narrowing fissure, at a depth of 150 to 200 feet, put an end to mining operations early in the '70's, and they have never been resumed. A highly productive oil field has been developed on either side of this fissure at a depth of 1700 or 1800 feet below the surface The wells drilled close to the fissure yield oil only sparingly, while those a few hundred feet distant are of fair size (20 to 50 barrels daily), thus proving that the Grahamite is a chemically altered by-product of petroleum which has *escaped upward from below,* and that the fissure has not been *filled from above,* as some have supposed. The main productive oil rock underlying the region of the fissure is the Big Injun Sand, but many wells have also yielded oil from the "Salt Sand" above, and it is possible that the Cow Run beds may also have contributed their quota of petroleum escaping through the fissure until its walls caved in and arrested the flow.

From this short sketch, as well as that given in Chapter I, it will readily appear that the oil history (which began in a

commercial way long before Col. Drake drilled his famous well near Titusville in 1859) of Ritchie county is of very great interest.

Many wells have been drilled within its boundary, and several of their records will now be given:

Flannagan Heirs' Gas Well.

Toll Gate Well, Cabin run. Authority, E. H. Jennings & Bros.

	Feet.		Feet.
Sand	95	to	105
Sand	150	"	175
Hard Sand	210	"	230
Lime	364	"	384
Blue sand	410	"	420
Lime	470	"	480
Lime	560	"	580
Lime	700	"	720
Coal	755	"	758
Red rock	785	"	815
Coal	855	"	857
Hard sand	880	"	910
Black shales	910	"	920
Sand	920	"	985
Lime	985	"	995
Slate and shells	1110	"	1240
Sand, sharp and nice	1240	"	1300
Coal	1300	"	1302
Sand	1302	"	1312
Slate and shells			1440
Sand	1440	"	1500
Sand	1530	"	1570
Salt Sand (gas, 1620'; "break" at 1635')	1590	"	1668
Big Lime	1668	"	1740
Big Injun Sand, hard (gas)	1740	"	1824
Shelly sand	2030	"	2130
Sand	2240	"	2255
Sand and shells (gas)	2320	"	2330
Shells	2380	"	2390
Sand	2400	"	2412
Shells	2470	"	2475
Sand, probably Gordon	2486	"	2498
Bottom			2712

The Pittsburg coal horizon would belong somewhere between 400 and 500 feet in this record.

Mahaney Heirs' Well, No. 8.

On Bonds creek, one mile below Highland, and two and one-half miles north of Ellenboro. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	1060	to	1080
Salt Sand	1500	"	1600
Pencil cave	1794	"	1802
Big Lime	1802	"	1882
Keener Sand	1882	"	1894
Total depth			1905

"Gas in top of Keener; oil, 1888'; "pay," 5' thick." (Fifty to one hundred barrels.)

Calvin Butcher Well, No. 1.

Near Highland Postoffice, Bonds creek, Clay district. Authority, Mallory Brothers & Stewart.

	Feet.
Conductor	16
Ten-inch casing	320
Eight and one-fourth-inch casing	1132
Six and five-eighths-inch casing	1630
Keener Sand (gas, 1863'; oil, 1866')	1630
Total depth	1991

Morrison Well, No. 7.

Bonds creek, near Highland Postoffice. Authority, Mallory Bros. & Stewart.

	Feet.		Feet.
Wood Conductor			10
Ten-inch casing			374
Eight and one-fourth-inch casing			1235
Six and five-eighths-inch casing			1715
Top Maxton Sand	1890		
"Pay Sand" from	1904	to	1912
Top Keener Sand	1997		
Good Keener Sand	2005		
Total depth (top Big Injun Sand)			2015

"Mostly sand and shells in place of Big Lime and where the Keener "pay" should have been, had very nice white sand for ten feet."

J. M. Whaley Well, No. 2.

Bonds creek, near Highland Postoffice. Authority, Mallory Bros. & Stewart.

	Feet.	Feet.
Wood conductor		15

Top of Maxton Sand	1790		
First show of oil and gas			1806
Best show of oil and gas			1810
Bottom of sand			1814
Top of Keener Sand	1870		
First gas	1882		
Gas increased to about	1887		
Total depth (top Big Injun)			1912

"Very nice coarse Maxton Sand; break of about three or four feet; white slate between bottom of Maxton and Big Lime."

V. T. Butcher Well, No. 1.

One mile north of Highland Postoffice, Clay district. Authority, South Penn Oil Company.

	Feet.		Feet.
Maxton Sand	1832	to	1862
Big Lime	1862	"	1927
Keener Sand	1927	"	1950
Big Injun Sand	1950	"	2085

Creed Collins Well, No. 1.

Two miles and a half northeast of Pennsboro. Authority, Carter Oil Company.

	Feet.		Feet.
Coal	270	to	273
Coal (Pittsburg)	510	"	515
Cave	800	"	1100
Cow Run Sand	930	"	995
Salt Sand (water, 1332′)	1206	"	1400
Big Lime, hard (little black oil, 1800′)	1750	"	1850
Big Injun Sand, hard (gas, 1910′)	1850	"	1930
Berea Sand, soft	2200	"	2235
(Dry hole.)			

Cunningham Well, No. 1.

Near Pennsboro. Authority, Bettman, Watson & Company.

	Feet.		Feet.
Cow Run Sand	1056	to	1076
Gray sand	1200		
White sand (water, 1235′)	1245		
Shells and slate	1600		
Hard, white sand	1670		
Slate	1680		
Little Lime	1680	"	1705
Big Lime (6¼″ casing, 1715′)	1705	"	1760
Slate	1760	"	1765
Blue Sand (Keener)	1765	"	1770
Slate	1770	"	1776

White Sand (top Big Injun)	1776	"	1785
Slate	1785	"	1798
Coarse white sand (gas, 1814′)	1798	"	1825
Slate	1825	"	1830
White Sand (base Big Injun)	1830	"	1846
Shells and slate	1846	"	2040
Very hard black sand	2040	"	2100
Shelly	2100	"	2440
Dark gray sand (Gordon?)	2440	"	2470
Shelly sand	2470	"	2600
Bottom			2615

Smith & Co.'s Well, No. 1, on Wilson Farm.

Three miles southwest of Pennsboro. Authority, F. E. Boden.

	Feet.		Feet.
Coal (Pittsburg)	450		
Salt Sand	1370	to	1592
White sand	1670	"	1755
Shales	1755	"	1805
Light Amber Oil	1805	"	1815

Four and one-fourth-inch casing, 1780 feet, to shut off cave at 1200.

"Produced five to fifteen barrels per day of about 50° oil. This oil took the premium for finest crude oil in America at the World's Fair, Chicago. Wells drilled at all points of the compass around this one failed to find any other producers."

M. V. Yerkey Well, No. 1.

Two miles north of Ellenboro. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	500	to	750
First Cow Run Sand	800	"	815
Second Cow Run Sand	900	"	925
Salt Sand	1260	"	1360
Maxton Sand	1540	"	1560
Cave	1640	"	1660
Big Lime	1660	"	1740
Keener Sand	1740	"	1750
Big Injun Sand (oil, 1752′) (Five-barrel well.)	1750	"	1788

F. E. Boden & Co.'s Well, No. 1, Flannagan Farm.

Goose Neck Postoffice, three miles northeast of Harrisville. Authority, F. E. Boden.

	Feet.		Feet.
Coal (two feet) at	800		
Coal (three feet) at	1210		
Salt Sand	1400	to	1520

Big Lime	1628		
Big Injun Sand, good, white	1690	"	1795
Gas at 1715′; oil and more gas at 1793′.			
White sand	2360	"	2460
Shells and slate to bottom	2460	"	2821

N. F. Cannon Well, No. 1.

Near Harrisville. Authority, Ira DeWitt.

	Thickness Feet.	Depth Feet.
Clay	15	15
Limestone	10	25
Slate	10	35
Limestone	20	55
White slate	120	175
Limestone	25	200
Slate, white limestone and shells	75	275
Slate, red	25	300
Slate, white	75	375
Sand, white	30	405
Slate, white	85	490
Slate, red	20	510
Sand, white	10	520
Slate, red (no caves)	130	650
Slate, red	40	690
Limestone, white	20	710
Slate, red	165	875
Limestone, gray (cased 8¼″at 890′)	15	890
Slate, black	65	955
Limestone, gray	35	990
Sand, white	95	1085
Slate, white	55	1140
Sand, white	80	1220
Slate, black	30	1250
Sand, white	60	1310
Slate, black	110	1420
Sand, white	40	1460
Slate and hard sand, mixed	130	1590
Limestone, hard, gray (cased 6⅝″ at 1660′)	60	1650
Limestone, hard, white ("Big Lime")	47	1697
Keener Sand	20	1717
Big Injun Sand (Big gas at 1724′; slate break 5 feet at 1745′; oil at 1750′)	95	1812

The Washington coal crops at 75 feet above the derrick floor.

Jacob Moats Well, No. 1.

One mile south of Harrisville. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	1050	to	1150
Salt Sand	1175	"	1425
Big Lime	1690	"	1790
Big Injun Sand	1790	"	1880
Bottom			1903

The Whiskey Run Oil Pool lies about nine miles northeast from Cairo and three and one-half miles from Ellenboro, near the headwaters of Bond creek in northern Ritchie county. The first well was drilled there early in the '90's by Ira DeWitt and the South Penn Oil Company on the Hamilton farm. The well produced a little oil from the top of the *"Big Injun"* or *"Keener" Sand* horizon at 1,749 feet, and such a large quantity of gas just below that the well was utilized by the Mountain State Gas Company in its lines for several years. Finally the Associated Producers Company drilled in a well on the Baumgardner farm early in 1898, which started off at 20 barrels an hour, and the pool was thereafter rapidly developed. The record of the old Hamilton well, No. 1, as given by the South Penn Oil Company, is as follows:

Hamilton Well, No. 1.

On Whiskey run, Ritchie county, W. Va.

	Feet.		Feet.
Conductor	14	to	14
Red rock	26	"	40
Limestone	5	"	45
Slate, blue	10	"	55
Sand, white	115	"	170
Slate, blue	10	"	180
Red rock	5	"	185
Slate, blue	15	"	200
Slate, brown	5	"	205
Limestone shells	3	"	208
Red rock	10	"	218
Blue limestone	15	"	233
Sand, white	30	"	263
Red rock	25	"	288
Slate, blue	20	"	308
Red rock	50	"	358
Slate, blue	40	"	398
Limestone	5	"	403
Slate, blue	30	"	433
Red rock	40	"	473
Slate, blue	17	"	490

Sand, white	15	"	505
Slate, white	13	"	518
Slate, blue	20	"	538
Pink rock	5	"	543
Slate, dark	5	"	548
Slate, light blue	52	"	600
Red rock	10	"	610
Slate, brown	10	"	620
Slate, black	15	"	635
Red rock	40	"	675
Sand, white	10	"	685
Red rock	75	"	760
Slate, white	5	"	765
Red rock	20	"	785
Slate, blue	30	"	815
Coal, hard	5	"	820
Slate, dark	15	"	835
Red rock	30	"	865
Slate, brown	75	"	940
Coal, hard	5	"	945
Slate, blue	40	"	985
Slate, black (cased 6¼″ at 1020′)	35	"	1020
"Cow Run" Sand	20	"	1040
Sand, white	5	"	1045
Slate, black	90	"	1135
Sand and limestone	10	"	1145
Slate, blue	10	"	1155
Slate, black	15	"	1170
Slate, blue	90	"	1260
Sand and slate	36	"	1296
Slate, black	30	"	1326
Slate, white	10	"	1336
Slate, black	79	"	1415
Sand, gray	5	"	1420
Slate, dark	25	"	1445
Sand, white	5	"	1450
Slate, black	65	"	1515
Sand, gray	75	"	1590
Slate, dark	70	"	1660
"Big Lime" (Mountain)	88	"	1748
"Big Injun" Sand, white (oil and some gas at 1749′)	1	"	1749
Sand and limestone (gas at 1750′)	13	"	1762
Slate, black	4	"	1766
Sand, gray	16	"	1782

The *"Cow Run" Sand* of this well is certainly *below* the horizon of the *"First Cow Run,"* though not deep enough for

the "*Second*" one, but it is probably identical with the *Dunkard* or *Upper Mahoning sandstone.*

The record of the Baumgardner well, No. 1, of the Associated Producers Company was kept with much care by Prof. John F. Carll, the geologist for that corporation, and he gave the same to the Survey, as follows:

Baumgardner Well, No. 1. Whiskey Run Pool.

	Feet.		Feet.
Conductor	7	to	7
Unrecorded	8	"	15
Coal, Washington, show	..	"	...
Unrecorded	33	"	48
Shale, sandy	7	"	55
Sandstone, white (big water flow at 60′)	70	"	125
Slate	25	"	150
Sandstone and sandy shale	55	"	205
Shale, red	25	"	230
Coal (Uniontown?)	2	"	232
Slate, dark red (10″ casing at 245′)	83	"	315
Sand and slate, limy	55	"	370
Sandstone, hard, and red slate	25	"	395
Shale, red	45	"	440
Slate, sandy, gray and red	20	"	460
Sandy slate and flaggy sandstone	38	"	498
Coal, Pittsburg	7	"	505
Slate	120	"	625
Slate, sandy, black and red	30	"	655
Slate	85	"	740
Shale, dark "caving"	40	"	780
Slate	205	"	985
Red shale	50	"	1035
Slate and shale, variegated	35	"	1070
Slate, black (cased 8¼″, 1110′)	60	"	1130
Slate, white and gray	145	"	1275
Slate, dark and limy	80	"	1355
Coal, Kittanning horizon	2	"	1357
Slate	33	"	1390
Sand, gray, and shells	35	"	1425
Slate, black	25	"	1450

Sand and shale, dark	20	"	1470
Dark slate and sand	30	"	1500
Pottsville No. XII "Salt Sand": sand, white ....50 slate, dark ....80 sand, white ....25 sand, light gray....12 sand, hard......... 6 sand, medium hard, flaky ....26 sand, white, friable.21 sand, white, flaky...37	257	"	1757
Siliceous limestone **(Mountain Limestone)**	20	"	1777
Sand, fine (top **"Big Injun" "Keener"**)	18	"	1795
Sand, "pay," sugary	10	"	1805
Sand, fine, to bottom of well	22	"	1827

The coal reported at 498 feet comes in at the *Pittsburg* horizon, and is doubtless a representative of that stratum, but probably not so thick as represented, since only a few of the other wells have observed it so far as known. The bottom of this coal would come at 490 feet below the *Washington bed,* which crops out along the roadside just below the derrick, and 1,290 feet above the top of the *"Big Injun,"* which agrees well with what we should expect here.

The *"Salt Sand"* and *"Big Injun"* appear in the drillings to be almost continuous, but when examined with acid the *limestone* horizon separating them comes out very distinctly.

The Namon Barnes, No. 3, a famous producer, is in the valley, just below the Baumgardner well, and obtained its oil in two "pays," the first at 1,772 feet, producing a light green oil, and that at 1,780 feet a very light amber, as is much of the Whiskey run pool oil. Most operators consider that the production of the pool is from the *"Keener"* horizon of the *"Big Injun"* sand.

A few hundred feet distant from the Bamgardner well the Associated Producers Oil Company drilled another on the land of Mr. Brooks, and the record of this well, which was preserved by Mr. Carll, is so peculiar that it is given here, as follows:

Record of Brooks Well, No. 1, Whiskey Run Pool.

	Feet.		Feet.
Unrecorded	530	to	530
Pittsburg Coal	5	"	535

Unrecorded	505	"	1040
Limy shale and sand	10	"	1050
Unrecorded	50	"	1100
Sand, grayish white	10	"	1110
Unrecorded	90	"	1200
Sand	20	"	1220
Unrecorded	30	"	1250
Sand	40	"	1290
Coal, thin	..	"	....
Sand	10	"	1300
Unrecorded	150	"	1450
Coal	5	"	1455
Unrecorded	145	"	1600
Slate	10	"	1610
Sand, white	70	"	1680
Coal (?) or **Asphalt (saturated with oil)**	8	"	1688
"Big Lime" (Mountain)	67	"	1755
Big "Injun" Sand { **sand**, fine, soft (oil 1761′) ....10; sand, white .... 5; sand and slate .... 4; sand to bottom ....54 }	73	"	1828

The *coaly material* at 1,680 feet, resting immediately upon the *Mountain Limestone,* was saturated with petroleum, and described by the drillers as quite difficult to penetrate, "drilling like rubber," as one expressed it. Its location immediately on top of the limestone is so unusual that I suspect it might be a substance similar to grahamite, and a proximate analysis made by Prof. B. H. Hite, the chemist of the Survey, gave the following results, compared with the composition of grahamite:

Analysis of Bituminous Matter From Brooks Well, No. 1.

	Brooks No. 1.	Grahamite.
Moisture	00.21	00.26
Petroleum	1.40	.....
Volatile matter	34.21	58.37
Fixed carbon	48.82	39.24
Ash	15.36	2.13
	100.00	100.00
Sulphur	1.13	1.25

This analysis shows that the *bituminous matter* is not typical grahamite, though its anomalous stratigraphical position, limited

distribution (for other wells drilled all around Brooks, No. 1, failed to find the deposit), and saturation with petroleum, are all fairly conclusive evidence that the *bituminous material* is not *coal,* whatever else it may prove to be upon further examination.

The only other locality in the State where *coaly material* has been reported at this horizon is on Leading creek, in Calhoun county, where, in a well drilled by the Sill Oil Company upon the Metz farm, Mr. W. K. Jacobs reports that five feet of material which resembled *coal* in appearance was encountered at 1,631 feet, only two feet above the *Mountain Limestone,* and 108 feet above the *"Big Injun" oil sand.* Hence it is quite probable that along this same line where the great fissure on Macfarlan was made and filled with the products of petroleum, to be converted into the mineral, grahamite, by subsequent chemical changes, other minor fissures would originate, thus giving rise to such deposits as those struck in the Brooks and Metz borings.

Abicht Well, No. 1.

Whiskey run. Authority, Prof. John F. Carll.

	Feet.		Feet.
Top of Sand, gas	70	to	1420
Slate and red rock	302	"	1722
Big Lime	65	"	1787
Keener Sand	25	"	1812
Slate	10	"	1822
Big Injun Sand	7	"	1829

James Starr Well, No. 1.

About three miles south of Harrisville. Authority, Carter Oil Company.

	Feet.		Feet.
First Coal (Waynesburg "A"?)	180	to	182
Second Coal (Waynesburg?)	230	"	233
Cow Run Sand	1000		
Salt Sand	1050		
Maxton Sand (show of oil and gas at 1580')	1539		
Big Lime	1725		
Big Injun Sand	1825		
Total depth			1941
(Dry.)			

G. W. Hayhurst Well, No. 1.

Near Pullman, six miles east of Harrisville. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	502	to	505
Cow Run Sand	940	"	970
Salt Sand	1240	"	1280
Maxton Sand	1630	"	1696
Big Lime	1786	"	1836
Big Injun Sand	1836	"	1851
Berea Sand	2100	"	2200
Gordon Sand	2560		
Total depth			2675

W. I. Lowther Well, No. 1.

Near Pullman Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	500	to	506
Cave	675	"	960
Cow Run Sand	960	"	978
Salt Sand	1080	"	1175
Second Salt Sand	1280	"	1370
Third Salt Sand	1470	"	1590
Maxton Sand	1620	"	1659
Big Lime	1705	"	1805
Big Injun Sand (poor)	1805	"	1810
Berea Sand	2070	"	2085
Total depth (dry)			2128

C. D. Allender Well, No. 1.

One mile northwest of Oxford. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	920	to	1190
Cow Run Sand	1190	"	1210
Salt Sand	1444	"	1479
Salt Sand	1524	"	1664
Maxton Sand	1958	"	1978
Pencil cave	1235	"	1250
Big Lime	2075	"	2150
Big Injun Sand (gas, 2156′; oil, 2160′)	2150	"	2182
Total depth			2184

(Fair gas well.)

Two to three miles southwest from Oxford and in the vicinity of Whiteoak, some fairly good oil wells have been found in the Big Injun Sand. There are several small pools in the same general region known as the "Prunty," "Flannagan," "Ire-

land," "Holbrook," etc. The Pittsburg coal appears to have a good thickness in the region.

M. R. Pritchard Well, No. 1.

About one mile northeast of Prunty field, and one mile north of Whiteoak Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	480	to	485
Cow Run Sand	930	"	980
Salt Sand	1210	"	1397
Maxton Sand	1625	"	1683
Big Lime	1740	"	1835
Big Injun Sand	1825	"	1860
Berea?	2044		
Total depth			2700

John Pritchard Well, No. 1.

Whiteoak Postoffice, one mile west of Prunty field. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	385	to	391
Cave	600	"	800
Cow Run Sand	896	"	920
Salt Sand	1295	"	1429
Maxton Sand	1710	"	1740
Big Lime	1845	"	1935
Big Injun Sand	1935	"	1950
Berea?	2162	"	2167
Total depth			2207

Alexander Prunty Well, No. 1.

Two miles southwest of Oxford. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Pittsburg?)	150	to	155
Coal	445	"	550
Cow Run Sand	740	"	760
Salt Sand	1160	"	1204
Maxton Sand	1510	"	1525
Big Lime	1570	"	1585
Big Injun Sand	1611	"	1629
Total depth			1646

A coal is reported five to six feet thick at depths of 460 to 715 feet in all the rest of the wells on this farm up to No. 15, beyond which the Survey has no records.

Prunty Heirs' Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	635	to	641

Cow Run Sand	944	"	964
Salt Sand	1406	"	1446
Maxton Sand	1802	"	1827
Big Lime	1900	"	1962
Big Injun Sand	1962	"	1981
"Break"	1981		
Total depth			2039

Well No. 2—Pittsburg coal, 572 to 578 feet. Well No. 3—Pittsburg coal, 605 to 611 feet. Well No. 4—Pittsburg coal, 510 to 515 feet.

Lee Prunty Well, No. 1.

	Feet.		Feet.
Pittsburg Coal	750	to	755
Cow Run Sand	1200	"	1230
Salt Sand	1425	"	1475
Big Lime	2030	"	2080
Big Injun Sand	2082	"	2110
Total depth			2134

Well No. 2—Pittsburg coal, 710 to 715 feet. Well No. 3—Pittsburg coal, 650 to 653 feet. Well No. 4—Pittsburg coal, 590 to 596 feet. Well No. 5—Pittsburg coal, 685 to 688 feet.

Martin Heirs' Well, No. 1.

Prunty field. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	605	to	610
Cow Run Sand	1090	"	1105
Salt Sand	1250	"	1700
Maxton Sand	1785	"	1803
Big Lime	1885	"	1985
Big Injun Sand	1955	"	1985
Total depth			2020

Martin Heirs' Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	660	to	663
Cow Run Sand	1120	"	1145
Salt Sand	1260	"	1280
Maxton Sand	1745	"	1770
Big Lime	1850	"	1890
Big Injun Sand	1978	"	2010
Total depth			2036

G. P. Zinn Well, No. 1.

Prunty field. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	438	to	444

Cow Run Sand	500	"	730
Salt Sand	1040	"	1070
Maxton Sand	1622	"	1634
Big Lime	1675	"	1793
Big Injun Sand	1793	"	1825

M. G. Zinn Well, No. 1.

Prunty field. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	460	to	466
First Cow Run Sand	760	"	780
Second Cow Run Sand	920	"	945
Salt Sand	1185	"	1244
Maxton Sand	1630	"	1660
Big Lime	1720	"	1789
Big Injun Sand	1789	"	1834
Total depth			1855

Well No. 2, Pittsburg Coal	515	"	520
Well No. 3, Pittsburg Coal	665	"	670
Well No. 4, Pittsburg Coal	750	"	756
Well No. 5, Pittsburg Coal	712	"	718
Well No. 6, Pittsburg Coal	500	"	502

These records show that the Pittsburg coal gets quite thin (two to three feet) occasionally in this region, and hence these oil well records should be confirmed by the diamond drill before any serious investments for coal are made.

G. M. Ireland Well, No. 1.

Flannagan field, three-fourths of a mile southwest of Whiteoak. Authority, Hartman Oil Company.

	Feet.		Feet.
Pittsburg Coal	437		
Maxton Sand	1565	to	1615
Slate	1585	"	1589
Big Lime	1695		
Sand (Keener) (oil)	1763		
Big Injun Sand (gas, 1778'; oil, 1783')	1773	"	1799½

G. M. Ireland Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	584	to	589
Cow Run Sand	1075	"	1090
Salt Sand	1390	"	1430
Maxton Sand	1718	"	1781
Sand (Stray)	1830	"	1842
Big Lime	1864		

Big Injun Sand, white	1954	"	1960
Sand and lime	1970	"	2005

G. M. Ireland Well, No. 3.

	Feet.		Feet.
Pittsburg Coal	700		
First Cow Run Sand	1020	to	1050
Second Cow Run Sand	1200	"	1240
Gas Sand	1480	"	1553
Salt Sand	1615	"	1650
Salt Sand	1700	"	1745
Maxton Sand	1855	"	1895
Big Lime	1960	"	2039
Black Sand (Keener)	2039	"	2052
Big Injun Sand	2052	"	2060
Limy Sand	2060	"	2090
Lime	2090	"	2102
Sand	2102	"	2114
Slate to bottom	2114	"	2120

G. M. Ireland Well, No. 4.

	Feet.		Feet.
Pittsburg Coal	581		
Maxton Sand	1732	to	1780
Little Lime	1820	"	1845
Big Lime	1855		
Keener Sand	1925	"	1937
Bottom			1960

G. M. Ireland Well, No. 5

	Feet.		Feet.
Pittsburg Coal	409		
Maxton Sand	1588	to	1605
Big Lime (show oil, 1698′)	1691	"	1760
Keener Sand (oil, 1771 to 1775′)	1760	"	1788
"Streak"	1815	"	1825
Bottom			1827

G. M. Ireland Well, No. 6

	Feet.
Pittsburg Coal	490
Keener Sand	1840

G. M. Ireland Well, No. 8.

	Feet.		Feet.
Pittsburg Coal	620		
Big Injun Sand	1980	to	2000
Bottom (dry)			2088

G. M. Ireland Well, No. 10.

	Feet.
Pittsburg Coal	510
Big Injun Sand	1843
Bottom	1882¾

G. M. Ireland Well, No. 11.

	Feet.
Pittsburg Coal	387
Big Lime	1677
Keener Sand	1727
Bottom	1770

G. M. Ireland Well, No. 13.

	Feet.		Feet.
Pittsburg Coal	410		
Big Injun Sand	1747	to	1794
Bottom			1806

G. M. Ireland Well, No. 14.

	Feet.		Feet.
Pittsburg Coal	486		
Big Injun Sand	1826	to	1872
Bottom			1892

G. M. Ireland Well, No. 16.

	Feet.		Feet.
Pittsburg Coal	409		
Coal (Bakerstown?)	730	to	740
Salt Sand	1435		
Pencil cave	1532		
Big Lime (black oil show, 1690′)	1684		
Big Injun Sand (gas and oil, 1764′)	1749		
Total depth	1783		

(Forty-barrel well.)

Zimri Flannagan Well, No. 1.

Southwest extension of Prunty field, one mile northeast of Berea. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	406	to	414
Cave	700	"	780
Cow Run Sand	838	"	868
Salt Sand	1010	"	1360
Maxton Sand	1590	"	1650
Big Lime	1711	"	1787
Big Injun Sand	1786	"	1813
Total depth			1860

Zimri Flannagan Well, No. 12.

	Feet.		Feet.
Pittsburg Coal	520	to	530
Cow Run Sand	1021	"	1081
Salt Sand	1314	"	1429
Maxton Sand	1655	"	1730
Big Lime	1790	"	1875
Big Injun Sand (oil, 1891′)	1875	"	1903
Total depth			1935
(Thirty to fifty-barrel well.)			

Perry-Davis Well, No. 1.

Adjoining Zimri Flannagan farm. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	396	to	402
Cave	620	"	900
Cow Run Sand	900	"	940
Salt Sand	1200	"	1285
Maxton Sand	1580	"	1620
Big Lime	1640	"	1744
Big Injun Sand	1744	"	1775

Perry-Davis Well, No. 2.

	Feet.		Feet.
Pittsburg Coal	445	to	456
Cave	850	"	960
Cow Run Sand (hard)	960	"	1000
Salt Sand (water, 1280′)	1230	"	1340
Big Lime (hard)	1755	"	1806
Big Injun Sand (oil, 1814′)	1806	"	1835
(Seventy-five to 100-barrel well.)			

Perry-Davis Well, No. 6.

	Feet.		Feet.
Pittsburg Coal	406	to	418
Cave	600	"	900
Cow Run Sand	900	"	913
Salt Sand	1210	"	1290
Maxton Sand	1555	"	1600
Big Lime	1680	"	1752
Big Injun Sand (gas, 1755′; oil, 1759′)	1752	"	1778
(Ten-barrel well.)			

The exceptional thickness of Pittsburg coal reported from these wells should be tested with diamond drill for confirmation. The oil well drill is not a reliable test for either the quality or thickness of coal.

Festus Kelley Well, No. 1.

One mile and a half south of Whiteoak Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	364	to	373
Cave	560	"	620
Cow Run Sand	790	"	825
First Salt Sand	1169	"	1230
Second Salt Sand (water, 1315′)	1300	"	1335
Maxton Sand	1500	"	1555
Pencil cave	1640	"	1650
Big Lime (oil show, 1679′)	1664	"	1738
Big Injun Sand (light gas, 1741′)	1738	"	1756

(Practically dry hole.)

Maxwell Heirs' Well, No. 1.

Two miles from Berea, near Slab creek. Authority, Carter Oil Company.

	Feet.		Feet.
Cow Run Sand	1005	to	1075
Gas Sand	1310	"	1390
First Salt Sand	1520	"	1610
Second Salt Sand	1805	"	1845
Slate	1845	"	1850
Maxton Sand (gas, 1870′)	1850	"	1935
More gas	1965		
Big Lime	1995	"	2062
Big Injun Sand	2062		

J. R. Knight Well, No. 1.

Two miles northeast of Berea Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	545	to	550
Cave	800	"	975
Cow Run Sand	1045	"	1096
Salt Sand	1270	"	1450
Maxton Sand	1694	"	1762
Big Lime	1850	"	1926
Big Injun Sand (oil, 1935′)	1926	"	1954
Total depth			1960

(Five to ten-barrel well.)

H. C. Griffin Well, No. 1.

Near Holbrook. Authority, Carter Oil Company.

	Feet.		Feet.
Coal (Elk Lick?)	526	to	532
Salt Sand	810	and	944

Cave	1106		
Maxotn Sand	1590	to	1618
Big Lime	1618	"	1685
Big Injun Sand (gas, 1690′)	1685	"	1716
Total depth			1759

C. W. Nutter Well, No. 1.

Near Holbrook. Authority, Carter Oil Company.

	Feet.		Feet.
No Pittsburg Coal.			
Cave	575	to	825
Cow Run Sand	850	"	870
Second Cow Run Sand	945	"	975
Salt Sand	1170	"	1200
Maxton Sand	1607	"	1637
Big Lime	1660	"	1750
Big Injun Sand	1755	"	1799
Berea? Sand	1959	"	1971
Total depth			2061

M. B. Zinn Well, No. 1.

One mile west of Holbrook, two miles south of Prunty field. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	375	to	381
Cow Run Sand	804	"	830
First Salt Sand	1264	"	1305
Second Salt Sand	1350	"	1404
Maxton Sand	1550	"	1560
Big Lime	1671	"	1746
Big Injun Sand	1746	"	1770
Berea? Sand	1942	"	1957
Total depth			2001

James T. Sommerville Well, No. 1.

Near Auburn, southeastern corner of Ritchie county. Authority, Thomas E. Davis & Son.

	Feet.		Feet.
Cow Run Sand (gas)	925	to	950
First Salt Sand	1190	"	1230
Second Salt Sand	1240	"	1310
Red rock	1465	"	1545
Little Lime	1600	"	1700
Big Lime (show of oil)	1723	"	1745
Big Injun Sand	1745	"	1791
Slate, shells and sandstone	1791	"	1940

"Tools were stuck in a hard substance presumed to be cap of Berea Grit or Gantz Sand at 1,940 feet. No coal found in any

formation except some drift at surface about four feet thick presumed to be the Washington coal vein."

Amos Perrine Well, No. 1.

Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Conductor			16
Sand	16	to	38
Red rock	38	"	123
Sand	123	"	145
Red rock	145	"	205
Sand	205	"	225
Red rock and shells	225	"	275
Sand	275	"	303
Red rock	303	"	378
Slate	378	"	406
Red rock	406	"	504
Sand	504	"	518
Red rock and shells	518	"	570
Coal?	570	"	574
Red rock	574	"	649
Black slate	649	"	669
Red rock	669	"	679
Sand	679	"	689
Red rock	689	"	724
Sand	724	"	764
Red rock	764	"	794
Sand	794	"	804
White slate	804	"	884
Sand	884	"	976
Slate and shells	976	"	1040
Black slate	1040	"	1120
Shale	1120	"	1140
Cow Run Sand	1140	"	1214
Black slate	1214	"	1244
Sand	1244	"	1269
Black slate	1269	"	1339
Shell	1339	"	1344
Slate	1344	"	1414
Sand and lime	1414	"	1439
Salt Sand	1439	"	1504
Black slate	1504	"	1519
Sand	1519	"	1529
Red rock	1529	"	1555
Slate	1555	"	1565
Big Lime	1565	"	1661
Big Injun Sand	1661	"	1736
Slate and shells	1736	"	1981

Berea Grit?	1981	"	2041
Unrecorded	2041	"	2276
Sandy lime	2276	"	2291
Slate and shells	2291	"	2541
Shale	2541	"	2601
Red rock	2601	"	2629
Slate and shells	2629	"	2783
Depth			2783

David G. Law Well, No. 1.

Union district, near Lawford Postoffice, between Burnt House and Newberne. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	None		
Cave	550	to	682
Cow Run Sand	745	"	780
Salt Sand (oil, water and gas at 1140')	902	"	1187
Maxton Sand	1540	"	1582
Big Lime	1669	"	1702
Big Injun Sand	1730	"	1819
Total depth			2203

A. A. Clayton Well, No. 1.

One mile southwest of Lawford Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	680	to	930
Cow Run Sand	880	"	910
Salt Sand	1250	"	1525
Maxton Sand (gas, 1750')	1700	"	1765
Big Lime	1780	"	1850
Big Injun Sand (gas, 1870')	1850	"	1930
Berea (gas, 2244')	2236	"	2251
Total depth			2271
(Small gas well.)			

John Wass Well, No. 1.

Four miles northwest of Lawford Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal (absent).			
Cave	600	to	875
Cow Run Sand	875	"	890
Salt Sand	1455	"	1550
Maxton Sand (gas, 1590')	1560	"	1605
Big Lime	1675	"	1750
Big Injun Sand	1750	"	1840
Berea (all lime)	2125	"	2140

Total depth			2232

(Fair gas well in Maxton Sand.)

L. C. Goff Well, No. 1.

Three miles west of Lawford Postoffice, Murphy district, and three miles north of Burnt House. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	620	to	970
Cow Run Sand	1000	"	1010
First Salt Sand (water, 1275′)	1250	"	1300
Second Salt Sand	1350	"	1400
Maxton Sand (oil and gas, 1730′)	1700	"	1740
Big Lime	1830	"	1926
Big Injun Sand (show oil, 1925′)	1926	"	1986

(One-barrel well, in Maxton Sand.)

F. P. Goff Well, No. 1.

Spruce creek, four miles west of Lawford Postoffice. Authority, Carter Oil Company.

	Feet.		Feet.
Coal?	115	to	117
Cave	500	"	700
Cow Run Sand	700	"	730
Gas Sand	860	"	945
First Salt Sand	1000	"	1190
Second Salt Sand	1243	"	1393
Maxton Sand	1525	"	1555
Pencil cave	1570	"	1575
Big Lime (gas, 1620′)	1575	"	1680
Big Injun Sand (gas, 1722′)	1680	"	1740
Berea Sand	2008	"	2015
Total depth			2170

(Dry hole.)

The driller has identified the coal at top of this section with the Pittsburg bed, but it belongs about 200 feet higher than that stratum.

Harkness Well, No. 1.

Near Cornwallis, Grant district. Authority, Prof. John F. Carll.

	Thickness Feet.	Depth Feet.
Conductor		37
Unrecorded	73	110
Bluff Sand	60	170
Unrecorded	430	600
Little Dunkard Sand	15	615
Unrecorded	75	690

Second Dunkard Sand	35	725
Unrecorded	355	1080
First Salt Sand	40	1120
Black slate	35	1155
Second Salt Sand	95	1250
Unrecorded	50	1300
Hard Sand	10	1310
White sand	55	1365
Slate	5	1370
Gas Sand	20	1390
Black slate	38	1428
Oil sand (Maxton?) Cairo	45	1473

(Gas, 1433-36′; oil, 1450-70′; water, 1435′.)

Harkness Well, No. 2.

Near Cornwallis. Authority, Prof. John F. Carll.

	Thickness, Feet.	Depth, Feet.
Conductor		13
Unrecorded	262	275
Bluff Sand	65	340
Unrecorded	525	865
Big Dunkard Sand	35	900
Second Dunkard Sand	345	1245
First Salt Sand	45	1290
Unrecorded	30	1320
Second Salt Sand	100	1420
Unrecorded	80	1500
Gas Sand	50	1550
Slate	82	1632
Cairo (Maxton?) Oil Sand (1st pay, 1642′; 2d pay, 1647′)	25	1657

Gilbert Well, No. 1.

Cornwallis. Authority, Fisher Oil Company.

	Feet.
Cairo Sand (gas, 1491; oil, 1497′)	1473
Bottom	1506

Gilbert Well, No. 2.

	Feet.
Cairo Sand (gas, 1517′; oil, 1538′)	1507
Bottom	1541

Gilbert Well, No. 3.

	Feet.
Ten-inch casing	85
Eight and one-fourth-inch casing	700
Six and five-eighths-inch casing	1150
Cairo Sand	1467
Bottom	1510

William Hall Heirs' Well, No. 1.

Near Cairo. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	720		
Gas Sand	1320	to	1360
Salt Sand	1443	"	1469
Show of oil	790		
Show of oil and gas	1443		
Oil and gas	1457		
Total depth			1469

William Hall Heirs' Well, No. 2.

	Feet.		Feet.
Dunkard Sand (Cow Run)	735		
Gas Sand	1410	to	1445
Cairo Sand (Maxton)	1520	"	1552
Gas, 1527'; oil, 1543'.			

William Hall Heirs' Well, No. 3.

	Feet.		Feet.
Dunkard Sand (Cow Run)	785		
"Salt" Sand (Cairo, Maxton?)	1537	to	1595
Gas, strong	1538		
Oil	1575		
Water	1584		
Bottom			1600

William Hall Heirs' Well, No. 4.

	Feet.		Feet.
Cow Run Sand	940	to	1030
Gas Sand	1495	"	1527
Salt Sand (Cairo, Maxotn?)	1594	"	1640

Strong gas at 1594 feet; oil, 1630 feet, with increase to 1634 feet.

A. Hall Well, No. 1.

Cairo and Cornwallis district. Authority, South Penn Oil Company.

	Feet.
Salt Sand (Cairo, Maxton?)	1629
Gas	1629
Oil	1631
Bottom	1648

A. Y. Pew Well, No. 2.

One mile northwest of Cairo. Authority, Mr. Michael Hardy, Foreman, Clark Oil Company.

	Feet.
Top Carroll Sand	270
Pay at	275
Bottom Sand	295

The Carroll Sand lies about 200 feet above the Pittsburg coal, and is the highest oil horizon yet known in the State.

The following record will show its relation to the Cairo Oil Sand:

J. C. Lee Well, No. 10.

One mile northwest of Cairo. Authority, Mr. Michael Hardy, Foreman, Clark Oil Company.

	Feet.
Top Carroll Sand	320
First pay	325
Bottom Sand	345
Gas Sand (top)	1510
Salt Sand (Cairo, Maxton.)	1575
Oil at	1609
Bottom of hole	1623

"Ten-barrel well in Salt Sand in 1892, and making two barrels now (May 17, 1904)."

"The well produced fifteen barrels daily from the Carroll Sand at first, but was abandoned and drilled to the Cairo Sand after five months."

The record of Lee well No. 6, on the summit of a hill, one-half mile northwest from Cairo, was kept for the Survey with much care by William A. Clark, President of the Clark Oil Company, and it reads as follows:

Lee Well, No. 6.

	Thickness. Feet.	Depth. Feet.
Unrecorded	35	35
Coal (Washington or Waynesburg "A")	2	37
Unrecorded	213	250
Carroll Oil Sand	40	290
Red beds (10-inch casing(330 feet)	60	350
Lime "shells"	95	445
Red rock	35	480
White slate and "lime shells"	160	640
"Big" red bed	100	740
Black slate and lime	115	855
Unrecorded	20	875
"Pink cave" (8¼-inch casing)	10	885
Unrecorded to bottom of a sand	25	910
Black slate	50	960
Sand **Dunkard** (Cow Run)	40	1000
Slate, black	30	1030

Red rock	15	1045
Sandstone, very hard	10	1055
Limestone	15	1070
White slate and "shells"	50	1120
Sandstone	25	1145
Black slate and "lime shells"	47	1192
Sand	15	1207
Slate, black	33	1240
Sand	35	1275
Dark **Coaly** shales ("cave"), cased 6¼", 1310'	45	1320
"Casing sand"	40	1360
Shale, black	15	1375
Sand, pebbly (top "Salt Sand")	113	1488
Slate, black	10	1498
Shale, gray	10	1508
Slate	22	1530
"Gas Sand"	20	1550
Slate and shells	20	1570
Shale, gray	20	1590
Sand	10	1600
Shale, black	5	1605
Sandy beds, limy	5	1610
Sand, white	15	1625
Black slate and lime	20	1635
"Salt Sand," Cairo and **Maxton Oil Sand;** broken for 15 feet; very hard and dark, then whiter at 1660 feet, softer at 1680 feet, showing oil at 1682½ feet; through 'pay' at 1687 feet; sand harder, with bluish cast at 1690 feet, and making three barrels of salt water per hour; soft sand to bottom; total thickness	55	1700
"Big Lime" (Mountain Limestone) to bottom of well	35	1735

The top of the *"Big Injun" Sand* would be found at about 1,790 feet in this well, since the *Mountain Limestone* is 80 to 90 feet thick in the Cairo region, hence the base of the *Carroll Sand* comes here 1,500 feet above the *"Big Injun"* oil sand, and as the *Berea Grit* lies 495 feet below the top of the *"Big Injun" Sand*, as shown by the record of Hatfield No. 2, near Cairo, then this *Carroll Sand* would be 1,995 feet above the *Berea Grit* horizon at Cairo, thus showing a thickening of 200 feet between St. Marys and Cairo, since the Tan Lot well at St. Marys, Pleasants

county, 15 miles north of Cairo, found the *Berea* at only 1,790 feet below the base of the massive sandstone and *Macksburg coal* which crop out there, and the St. Marys *sand rock* appears to be identical with the *Carroll Sand* of this record.

The Cairo oil field was first opened in October, 1890, by Messrs. Boden and Aiken of Parkersburg. Their first well, which is now owned by the Cairo Oil Company, is situated one-fourth of a mile south from the railroad station, and the record reads as follows, according to Boden & Aiken, the original owners:

Boden & Aiken Well, No. 1.	Thickness Feet.		Depth Feet.
Conductor	16	to	16
Limestone	12	"	28
Shale	12	"	40
Sand	15	"	55
Shale	30	"	85
Shale, light	45	"	130
Sand, sharp, white **(Carroll Oil Sand)**	43	"	173
Shale (7⅝″ casing, 175′)	36	"	209
Coal	1	"	210
Sand, dark	11	"	221
Shale, light	12	"	233
Slate, red	16	"	249
Shale, light	12	"	261
Slate, red	10	"	271
Sand, dark gray	7	"	278
Slate	11	"	289
Slate, red	19	"	308
Shale, soft, blue	20	"	328
Shale, red	9	"	337
Limestone	10	"	347
Shale, light	52	"	399
Red rock	10	"	409
Shale, light	7	"	416
Red rock	2	"	418
Shale, light	5	"	423
Red rock	44	"	467
Shale, light	16	"	483
Sand	25	"	508
Red rock	15	"	523
Shale, light	11	"	534
Red rock	9	"	543
Shale, light	30	"	573
Red rock	5	"	578
Sand	55	"	633

Red rock	26	"	659
Shale, light	19	"	678
Red rock	20	"	698
Sand (5⅝-inch casing, 725′)	78	"	776
Shale, light	12	"	788
Shale, dark	25	"	813
Shale, red, sandy	13	"	826
Shale, light	92	"	918
Sand	5	"	923
Shale, black	10	"	933
Shale, light	135	"	1068
Sand, light	64	"	1132
Shale, light	26	"	1158
Shale, black	20	"	1178
Sand, **gas**	90	"	1268
Shale, gray	94	"	1362
Sand	10	"	1372
Shale	70	"	1442
Sand **(Cairo Oil Sand)**	57	"	1499
Shale	16	"	1515
Mountain Limestone "Big Lime" { **limestone** ....50 sand ....12 sand and limestone..12 }	74	"	1589
Sand "**Big Injun**" (oil, 1678′)	97	"	1686
Unrecorded to bottom	374	"	2060

The Cairo Sand (which is also often called "Salt Sand") comes just above the top of the Mountain Limestone or "Big Lime" of the drillers, and hence is most probably identical with the Maxton Sand of Tyler county. This latter oil sand was formerly supposed to be a member of the Pottsville or Salt Sand formation, but it is now known to a certainty that it belongs in the Mauch Chunk beds, since the *red shales* occur between the Maxton Sand, and the base of the Pottsville. Hence the Cairo Oil Sand which was formerly regarded as a member of the Pottsville formation by the writer, is not so regarded now, although no *red* shales appear between it and the Pottsville beds in the region of Cairo.

Eddy Well, No. 1.

Near Cairo. Authority, McCalmont Oil Company.

	Thickness. Feet.	Depth. Feet.
Conductor		10
Bluff Sand	40	50

"Mountain" Sand	120	170
Red rock	50	220
Mixed slate	40	260
Carroll Sand, fresh water	35	295
Slate	120	415
Slate and sand, mixed	65	480
Slate and red rock	75	555
Lime, sand and red rock mixed	45	600
Slate and red rock	40	640
Red rock, first cave	20	660
Limestone	45	705
Red rock and slate, mixed	145	850
Sand and slate	15	865
Big red rock cave (8¼" casing, 930')	65	930
Dunkard Sand (Cow Run)	60	990
White lime	30	1020
Slate and sand, mixed	80	1100
Black shale and slate	190	1290
Sand and lime, mixed	15	1305
Slate and cave	10	1315
Sand; gas and oil in top	25	1340
Cave, second streak	55	1395
Lime and sand (6¼" casing)	14	1409
Slate and lime, mixed	91	1500
Black lime	45	1545
Slate	30	1575
Gas Sand (gas, 1595')	55	1630
Slate	20	1650
Salt Sand (oil show, 1710'; water, 1716')	93	1743
Big Lime	97	1840
Big Injun Sand (little black oil in bottom)	83	1923
Slate	320	2243
Shell, with some gas (Berea)	5	2248
Slate	37	2285
Shells	10	2295
Bottom		2317

This record gives intervals between important strata and shows that the *Berea Sand* lies 500 feet below the top of the Big Lime, and about 1300 feet below the Cow Run or Dunkard Sand. The Pittsburg coal horizon would come at about 500 feet in this record.

Sleeth Well, No. 1.

Three-fourths of a mile south of Cairo. Authority, Cairo Oil Company. Top well 700' A. T.

	Feet.		Feet.
Salt Sand (Cairo, Maxton) (oil, 1500')	1455	to	1520

Big Injun Sand (gas, 1613-23′)	1605 "	1679
Oil shows	1628 and	1654

McGregor Well, No. 4.

Cairo. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded	1508	1508
Salt Sand (Cairo, Maxton) (oil, 1526′)	31	1539
Big Lime, etc.	97	1636
Big Injun Sand (dry)	128	1764
Pebbly slate	30	1794

McGregor Well, No. 5.

Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded	1471	1471
Salt Sand (unproductive)	17	1488
Unrecorded (Big Lime)	95	1583
Big Injun Sand (good pay, 1598′)	75	1658
(Eighty-five-barrel well.)		

McGregor Well, No. 6.

Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded	1616	1616
Salt Sand (Cairo, Maxton)	37	1653
Unrecorded (Big Lime)	102	1755
Big Injun Sand	130	1885

M. C. Sweeney Well, No. 1.

Near Cairo. Authority, South Penn Oil Company.

	Feet.
Gas Sand	1659
Pay	1700
Slate	1706
Salt Sand (Cairo, Maxton)	1745
First "pay"	1786
Total depth	1793

M. C. Sweeney Well, No. 3.

	Feet.
Gas Sand	1768
Pay	1809
Slate	1815
Salt Sand (Cairo, Maxton)	1881
First pay	1906
Bottom	1917

H. J. Lynch Well, No. 1.

Cairo. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	700	to	760
Gas Sand	1300	"	1370
Salt Sand (Cairo, Maxton) (oil, 1469′)	1457	"	1478

A. M. Douglass Well, No. 2.

Three-fourths of a mile south of Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
Salt Sand (oil)	1468	to	1500
Dark sand	1500	"	1502
Sand, show oil	1502	"	1530
Gas and oil, show	1530	"	1538
Sand	1538	"	1546
Slate	1546	"	1559
Dark lime } Big Lime	1559	"	1574
White lime } Big Lime	1574	"	1648
Big Injun Sand (show oil, 1661′)	1648	"	1757
Total depth			1858

R. Moats Well, No. 2.

One mile south of Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand (no gas)	1626	to	1646
Top Salt Sand (Cairo, Maxton)	1650		
First oil	1700		
Good Sand to	1708		
Hard, white sand to	1711		
Better sand, more oil	1715		
Bottom of well	1717		

J. Moats Well, No. 4.

One mile south of Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand (gas, 1618′)	1585	to	1638
"Break" slate	1638	"	1672
Salt Sand (Cairo, Maxton) oil, 1694 and 1705′	1672	"	1710
Keener Sand (Big Injun) oil	1820	"	1839

J. Moats Well, No. 5.

	Feet.		Feet.
Well mouth 870′ A. T.			
Gas Sand, nearly all sand from	1385		
Salt Sand (Cairo, Maxton) oil, 1715′	1690	to	1728
Big Injun or Keener Sand (gas and oil)	1831	"	1842
Total depth			1852

J. H. Davidson Well, No. 6.

Two miles south of Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand	1568	to	1626
Salt Sand (Cairo, Maxton) show gas, 1705'; oil, 1715'	1664	"	1740
Top Keener Sand (little gas, 1831')	1815		
Big Injun Sand	1851	"	1942
Total depth			1969

J. H. Davidson Well, No. 7.

	Feet.		Feet.
Gas Sand (little gas, 1370')	1320	to	1378
Salt Sand (little oil, 1454'; gas, 1472')	1407	"	1480
Top of Keener Sand	1548		
Strong gas	1558		
Bottom well			1568

"This is the only good gas well struck near Cairo."

Fred Fickey Well, No. 2.

Three and one-half miles south from Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand (gas, 1760')	1726	to	1805
Salt Sand (no break)	1805		
First oil	1860		
Bottom of well			1860

Fred Fickey Well, No. 6.

1800 feet west and a little south of Fickey well, No. 2.

	Feet.		Feet.
Gas Sand (no gas)	1565	to	1604
Salt Sand (show oil, 1698')	1660	"	1715
Big Injun Sand (no oil or gas)	1785	"	1900
Squaw Sand (gas, 1909')	1905		
Another sand (12 feet)	1929		
Bottom of well			1940

Fickey Well, No. 8.

300 feet north of Fickey No. 6.

	Feet.		Feet.
Gas Sand (little oil, 1700')	1640	to	1734
Salt Sand (Cairo, Maxton) dry	1734	"	1762
Big Injun Sand (gas, 1943'; big gas, 1977') (show oil, 1987')	1855	"	1987
Slate	1987	"	1992
Shell Sand (Squaw) to bottom	1992	"	2006½

Nunemaker Well, No. 1.

One mile south of Fickey No. 8, and little west, and four miles south of Cairo. Authority, Cairo Oil Company.

	Feet.		Feet.
No Gas Sand.			
Salt Sand (water, 1797'; oil, 1815')	1774	to	1841
Big Injun Sand, top	1950		
Little gas	2042		
Finished	2045		

G. W. Twyman Well,.

Three miles southwest Petroleum Station. Authority, Robert Wallace.

	Feet.		Feet.
First Cow Run Sand	706	to	731
Second Cow Run Sand	796	"	851
Third Cow Run Sand	1148	"	1217
Top Salt Sand	1487		
Black slate	1540		
Second Salt Sand	1548	"	1578
Big Lime	1578	"	1628
Black slate	1661		
Big Injun Sand	1661	"	1740

"Good Sand; some oil; no water in any sand."

J. M. Lewis Well, No. 1.

Near Rusk Postoffice, in western edge of county. Authority, F. E. Boden.

	Thickness. Feet.	Depth. Feet.
Conductor	20	20
Shale, white	10	30
Red rock[1]	100	130
Sandstone, Bluff	35	165
Shale, black (10-inch casing)	5	170
Red rock	75	245
Shale, white	25	270
Lime	30	300
Red rock	40	340
Shale, black and white	15	355
Sandstone	10	365
Red rock	130	495
Shale, white	20	515
Sandstone, white	15	530
Red rock	60	590
Lime	35	625
Shale, white (8¼-inch casing)	25	650

Little Dunkard, First Cow Run Sand	20	670
Red rock	10	680
Shale, black	10	690
Big Dunkard Sand (Mahoning)	55	745
Slate, black	10	755
Slate, white	160	915
Sandstone, white (gas, 970′)	75	990
Slate, white	15	1005
Sand	60	1065
Cave and slate (6¼″ casing)	35	1100
Sandstone (top of Pottsville)	63	1163
Slate, white	47	1210
Slate, black	35	1245
Lime	15	1260
Sandstone, white	55	1315
Slate, black	8	1323
Sandstone, white (Gas Sand)	54	1377
Lime	5	1382
Sandstone, white	40	1422
Slate, white	5	1427
Salt Sand (Cairo, Maxton)	42	1469
Sandstone, black	13	1482
Sandstone, white	15	1497
Big Lime	38	1535
Keener Sand	30	1565
Sand and slate, black	10	1575
Big Injun Sand (gas, 1595′)	72	1647
Slate and shale, black, to bottom	178	1825

This detailed section shows that the "Gas Sand" of the Cairo region is probably the basal member of the Pottsville formation, and therefore entirely another and lower horizon than the "Gas Sand" of Marion, Wetzel, etc., which belongs in the Allegheny formation, and probably the sand struck at 915 feet in this record.

W. A. Flesher Well, No. 1.

One-half mile south of Smithville. Authority, Carter Oil Co.

	Feet.		Feet.
Coal	290	to	293
Cow Run Sand	830	"	870
Coal?	1200	"	1212
Salt Sand	1250	"	1330
Big Lime	1690	"	1741
Big Injun Sand	1741	"	1772
Total depth			1892

W. B. Holt Well, No. 1.

South fork Hughes river, two miles below Smithville. Authority, Carter Oil Company.

	Feet.		Feet.
Macksburg? Coal	140	to	145
Cave	580	"	780
Cow Run Sand..........................	780	"	800
Salt Sand (oil, 1497′)..................	1481	"	1502
Total depth			1509
(Five-barrel well.)			

A. Wright Well, No. 4.

One mile southeast of Mellin, Murphy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Gas Sand	1590	to	1612
Salt Sand (oil, 1714 to 1722′; water, 1724′)	1647	"	1734
(Ten-barrel well.)			

D. Eddy Well, No. 4.

One mile southeast of Mellin, Murphy district. Authority, South Penn Oil Company.

(Steel line.)	Feet.		Feet.
Gas Sand	1513	to	1533
Salt Sand (oil, 1645-52′; water, 1664′)...	1573	"	1664
(Five barrel well.)			

C. Campbell Well, No. 8.

One mile and a half southeast of Mellin. Authority, South Penn Oil Company.

	Feet.		Feet.
Gas Sand (gas, 1532′)..................	1522	to	1582
Salt Sand (gas, 1596′; oil, 1697′; water 1678′)	1590	"	1700
(Ten-barrel well.)			

The record of a well drilled within 300 feet of the Ritchie Mine (fissure holding grahamite) on Macfarlan run, was published in Vol. 1, pages 308-9. In this well only a small quantity of oil was found. This *Sand was* good but the "well acted as though the Sand had been drained." Other wells drilled farther away from the fissure however, secured good producing sand as shown by the following records:

Dolan Well, No. 1.

600 feet west of south of Ritchie Mines, Murphy district. Authority, Cairo Oil Company.

	Feet.		Feet.
Conductor			9
Ten-inch casing	500		
Eight and one-fourth-inch casing	1060		
Six and one-fourth-inch casing	1460		
Four and seven-eighths-inch casing	1868		
Salt Sand (gas, 1807′; oil, 1819′; water, 1835′)	1752	to	1860
Keener Sand (oil and gas, 1920′)	1915	"	1932
Big Injun Sand, limy for 50 feet	1932	"	2030
Slate	2030	"	2045
Squaw Sand (two screws)	2045		
Bottom			2067

(Fifty to seventy-five-barrel well.)

Dolan Well, No. 3.

1000 feet west of south of Ritchie Mines. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand (little gas)	1670	to	1748
Salt Sand	1748	"	1857
Little gas	1815		
Little black oil	1822		
More oil	1834		
Water and more oil	1846		
More water	1852		
Big Lime	...		
Keener Sand (no oil)	1942	"	1980
Big Injun Sand, white and good	1980	"	2025
Total depth			2068

(Fifty to seventy-five barrel well.)

Furry Well, No. 4.

1000 feet west of south of Ritchie Mines. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand	1610	to	1630
Slate	1630	"	1730
Salt Sand, top	1730	"	1745
Slate	1745	"	1762
Salt Sand (gas, 1772′; gas and oil, 1780′)	1762	"	1821
Keener Sand	1883	"	1905
Lime	1905	"	1925
Big Injun Sand (oil)	1925	"	2013

(Fifty to seventy-five-barrel well.)

F. Pribble Well, No. 2.

One-half mile south 12° west of Ritchie Mines. Authority Cairo Oil Company.

	Feet.		Feet.
Gas Sand	1430	to	1442
Salt Sand	1461	"	1479
Shale "break"	1479	"	1497
Salt Sand (little gas)	1499		
First oil	1507		
Hard sand	1520		
Good sand to	1530		
Sand, very white, to	1536		
Good sand and more oil	1545		
Bottom	1549		

L. Lemmons Well, No. 1.

One mile east of Macfarlan. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand (gas, 1335′)	1300	to	1425
Salt Sand	1434	"	1541
Good gas at	1444		
Break, slate	1469	"	1481
Little oil at	1500		
Big Injun Sand (oil, 1631′; gas, 1636′)	1631	"	1730
Shells and slate	1730	"	1783

F. J. Lemmon Well, No. 1.

One-half mile east of Macfarlan. Authority, Cairo Oil Company.

	Feet.		Feet.
Gas Sand	1550	to	1580
"Break" (slate)	...	"	....
Salt Sand (gas, 1645′; gas and oil show, 1685′)	1625	"	1732
Drilled through Big Lime and Big Injun Sand. Top of Big Injun Sand	1795		
Slate and hard, poor sand, break at	1900		
Bottom well	1921		

"Little gas in Keener."

A. E. Ryan Well, No. 1.

Near Macfarlan. Authority, South Penn Oil Company.

	Feet.		Feet.
Coal	220		
First Cow Run Sand	716	to	734
Second Cow Run Sand	925	"	940
Sand	1200	"	1305
Gas Sand (first)	1467	"	1505
Gas Sand, (second)	1552	"	1601

Salt Sand	1605	"	1732
Big Lime	1735	"	1813
Big Injun Sand	1813	"	1898
Total depth			2326

Simon Stearns Well, No. 1.

Murphy district. Authority, South Penn Oil Company.

	Feet.		Feet.
Sand	8	to	88
Shale	88	"	263
Shale, red rock	315	"	770
Sand	770	"	800
Red rock	800	"	923
Cow Run Sand	923	"	978
Shale	978	"	1200
Sand	1200	"	1260
Shale	1260	"	1373
Salt Sand	1373	"	1473
Shale	1473	"	1598
Cairo or Maxton Sand	1598	"	1650
Black shale	1650	"	1678
Big Lime	1678	"	1762
Big Injun Sand	1762	"	1857
Total depth			2838

Frederick Miller Well, No. 1.

Authority, South Penn Oil Company.

	Feet.		Feet.
Sand	170	to	270
White sand	270	"	295
Sand	295	"	335
White slate	335	"	355
Sand	355	"	445
Slate	445	"	465
Lime	465	"	615
Red rock	615	"	635
White slate	635	"	670
Sand	670	"	710
Slate	710	"	735
Sand	735	"	740
Black slate	740	"	745
Sand	745	"	761
White slate	761	"	776
Black slate	776	"	821
Red rock	821	"	866
Cow Run Sand	866	"	910
White slate	910	"	960
Limestone	960	"	1035
Black slate	1035	"	1095

Sand	1095	"	1137
Black slate	1137	"	1237
Sand	1237	"	1287
Black slate	1287	"	1357
Gas Sand	1357	"	1387
White slate	1387	"	1397
Gas Sand	1397	"	1425
White slate	1425	"	1447
Cairo Sand (Maxton)	1447	"	1490
Strong gas	1456		
Oil, small show	1474		
Oil, best	1476		
Bottom			1506

Frederick Miller Well, No. 3.

	Feet.		Feet.
Salt Sand (Cairo, Maxton)	1609		
Gas	1629		
Oil show	1650		
Keener Sand	1753	to	1763
Big Injun Sand	1768	"	1885
Total depth			1896

Frederick Miller Well, No. 4.

	Feet.		Feet.
Salt Sand (gas, 1656'; little oil, 1667')	1652		
Keener Sand (oil, 1786')	1781	to	1800
Big Injun Sand	1800	"	1910

WOOD COUNTY WELL RECORDS.

Wood county lies directly west from Ritchie and southwest from Pleasants, and hence comes within the productive oil region of the State.

The Burning Springs-Eureka anticlinal uplift passes northward (N. 10° E.) through its extreme eastern corner, and hence the county's oil history began in the early 60's soon after oil had been developed in the adjoining county of Wirt, although its modern development did not begin until the early 90's.

The "Shallow" or "Cow Run" Sands of Wood have probably produced more oil than the deeper ones ("Salt", Big Injun, and Berea) though these latter have all proven productive in the eastern half of the county.

Very little oil has been found west from the Little Kanawha river, apparently because the rocks are there beyond the limit of the structural disturbance of the Burning Springs anticlinal, and

hence are nearly horizontal. In drilling through them numerous "shows" of oil and gas are found in all of the regular sands but not in paying quantity.

The Berea Grit, or Macksburg Sand of Ohio, is the lowest stratum which has yet produced any oil in Wood county. It lies 340 to 380 feet below the Big Injun Oil Sand, and below it nothing but slate (except a "grit" or "shell" at 1610 feet) has been found down to a depth of 1923 feet below the Berea as we learn from the record of the *Mount Farm Deep Well, No. 16,* just east from the Wood county line, the record of which is given on pages 299-300, Vol. I, 1899.

The following well records will illustrate the rock succession in Wood county:

Well No. 1, Section B, Lot 47.

Near Volcano. Authority, Pontius and Stiles.

	Thickness. Feet.	Depth. Feet.
Conductor	8	8
Sandstone, yellow	4	12
Soapstone, white	15	27
Shale, black	20	47
Shale black	11	58
Sandstone	12	70
Shale, black	6	76
Sandstone	39	115
Sandstone, hard, white	3	118
Shale, black	6	124
Coal	4	128
Shale, white	27	155
Sandstone	15	170
Shale, black	5	175
Sandstone, white	60	235
Sand, black	5	240
Shale, blue	43	283
Sandstone, gray	14	297
Sandstone, white	30	327
Sandstone, gray	33	360
Sandstone, black	6	366
Shale, blue	52	418
Sandstone, gray	10	428
Pebble	17	445
Sand and pebble	19	464
Sandstone, gray	2	466
Sandstone, white and yellow	9	475

Sandstone, gray	3	478
Sandstone, white	4	482
Sandstone, fine, white	2	484
Pebbly sandstone	2	486
Sandstone, brown	6	492
Sandstone, white	8	500
Sandstone, white, fine	17	517
Sandstone, white	8	525
Big Lime	15	540
Oil Sand (Keener)	45	585
Shale, black	18	603
Sandstone, gassy (Big Injun)	37	640

Volcano Well, No. 46.

Authority, Pontius and Stiles.

Well began about fifty feet under coal.	Feet.		Feet.
Unrecorded to			791
Macksburg, Berea Sand good show of oil.	791	to	801
Slate, (small flow of gas at 1438′)	801	"	1438

E. S. Butcher Well, No. 1.

Near Kanawha Station. Authority, Dr. Hopkins.

	Thickness. Feet.	Depth. Feet.
Quicksand		15
Conductor		26
Limestone and shells	34	60
Hard limestone	90	150
Limestone, shells and slate	268	418
Coal (Redstone?)	1	419
Sand, show of oil	27	446
Coal (Pittsburg?)	1	447
Limestone, shells and slate	138	585
Red cave	240	825
Unrecorded and hard sand shell	30	855
Very black slate	15	870
Boulder "cave"	25	895
Second Cow Run Sand (show of oil)	205	1100
Sand, water, gas and flow of salt water	50	1150
Sand	20	1170
Sand	130	1300
Broken sand and slate	90	1390
Salt Sand	110	1500
Big Lime	90	1590
Slate	10	1600
White sand	5	1605
Hard, dark, broken sand and lime	320	1925
Unrecorded	120	2045
Black slate, with shell (Berea) at top		

(show of oil)	15	2060
Limy sand, black and grayish black shale, with much lime	146½	2206½

Ralston Gas Well.

Union district. Record obtained from Long Reach Oil Company.

	Thickness. Feet.	Depth. Feet.
Surface		20
Green sand	20	40
Slate	550	590
First cave	50	640
Slate	125	765
Cow Run Sand (or shells)	30	795
Slate	40	835
Cave	35	870
Slate	180	1050
Ralston Sand (oil)	70	1120
Slate	40	1160
Upper Salt Sand	40	1200
Slate	145	1345
Lower Salt Sand	110	1455
Slate	20	1475
Big Injun Sand	145	1620
Slate	280	1900
Stray Sand	10	1910
Slate	86	1996
Berea Grit { white sand ....12′ dark gray sand..... 8′ }	20	2016
Bottom of well	29	2045

James A. Kelly Well, No. 1.

One mile northeast of Tallyho Postoffice, Union district. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Dunkard Sand	1070	to	1085
Salt Sand	1336	"	1410
Big Injun Sand	1690	"	1876
Berea (gas, heavy, 2184′)	2184	"	2198

W. S. Williamson Well, No. 1.

Ogdin—Hendershot field, Union district. Authority Union Oil Company.

	Feet.		Feet.
Berea	2123	to	2133
Gas	2123		
Oil	2123	"	2133

W. S. Williamson Well, No. 2.

	Feet.		Feet.
Berea Sand	2145	to	2156
Gas	2145		
Oil	2145	"	2156
Total depth			2184

W. S. Williamson Well, No. 3.

	Feet.		Feet.
Ten-inch casing	415		
Eight and one-fourth-inch casing	1185		
Six and five-eighths-inch casing	1820		
First Cow Run Sand	960		
Second Cow Run Sand	1020		
Salt Sand	1480		
Big Injun Sand	1700		
Berea (gas and oil)	2190	to	2200

W. S. Williamson Well, No. 4.

	Feet.		Feet.
Bottom of Big Injun Sand	1790		
Berea Grit	2158	to	2169
Slate	2169	"	2179
Total depth			2183

W. S. Williamson Well, No. 5.

	Feet.		Feet.
Cave	795		
First Cow Run Sand	970	to	1000
Second Cow Run Sand	1200	"	1220
Salt water at	1770		
Big Injun Sand	1775	"	1800
Berea Sand	2190	"	2202
Bottom of well			2211½

W. S. Williamson No. 6, got Berea	2117	to	2131
W. S. Williamson No. 7, got Berea	2200	"	2211
W. S. Williamson No. 8, got Berea	2273	"	2283

L. M. Newbanks Well, No. 1.

Union district. Authority, Union Oil Company.

	Feet.		Feet.
Ten-inch casing	342		
Eight and one-fourth-inch casing	921		
Six and five-eighths-inch casing	1760		
Berea Grit (gas and oil)	2109	to	2119
Bottom of hole			2128

L. M. Newbanks Well, No. 2.

	Feet.		Feet.
Berea Sand	2226	to	2239

Gas	2226		
Oil	2226	"	2237

L. M. Newbanks Well, No. 3.

	Feet.		Feet.
Berea (gas, 2170′; oil, 2170 to 2187′)	2170	to	2187
Total depth			2199½

L. M. Newbanks Well, No. 4.

	Feet.		Feet.
Cow Run Sand	1000		
Big Injun Sand	1685	to	1830
Berea Sand (gas, 2171′; oil and gas, 2171′ to 2185′)	2171	"	2185

L. M. Newbanks Well, No. 5.

	Feet.		Feet.
Caving places	800	to	1100
Cow Run Sand	990	"	1010
Salt Sand	1550	"	1580
Salt water at	1770		
Big Injun Sand	1770	"	1910
Berea Sand (oil and gas)	2254	"	2268

Pratt Well, No. 1.

Union district. Authority, Union Oil Company.

	Feet.		Feet.
Cave	800	to	1130
Cow Run Sand	1180	"	1220
Salt Sand	1600	"	1640
Big Injun Sand (water, 1760′)	1760	"	1910
Berea Grit	2285	"	2393

Makin Well, No. 1.

Near Ogdin. Authority, McCalmont Oil Company.

	Feet.		Feet.
Ten-inch casing	350		
Eight and one-fourth-inch casing	777		
Six and five-eighths-inch casing	1185		
Five and three-sixteenths-inch casing	1745		
Berea (oil, 2112′)	2106	to	2118½
Total depth			2126

Makin Well, No. 2.

	Feet.		Feet.
Berea (oil, 2033′)	2029	to	2040
Total depth			2042

Makin Well, No. 3.

	Feet.		Feet.
Berea (oil, 2054′)	2051	to	2061
Total depth			2068

Makin Well, No. 4.

	Feet.		Feet.
Berea (oil, 2140′)	2136	to	2146
Total depth			2160

Noah Ogdin Well, No. 2.

Ogdin Pool, Union district. Authority, Union Oil Company.

	Feet.		Feet.
Cow Run Sand	1033	to	1073
Big Injun Sand	1670	"	1764
Berea (gas and oil)	2154	"	2163
Bottom			2182

Montgomery Well, No. 2.

Union district. Authority, U. S. Oil Company.

	Feet.		Feet.
Cow Run Sand (oil, 1270′)	1260	to	1330
Salt Sand	1590	"	1645
Maxton Sand	1690	"	1780
Big Injun Sand	1850	"	2075
Berea Grit (oil, 2340 to 2347′)	2340	"	2351
Bottom			2361

Montgomery Well, No. 3.

	Feet.		Feet.
Cow Run Sand	1225	to	1370
Salt Sand	1550	"	1595
Maxton Sand	1650	"	1740
Big Lime	1740	"	1800
Big Injun Sand (water, 1820′ and 1860′)	1800	"	1960
Berea Grit (gas and oil, 2302′)	2300	"	2311½
Bottom			2321½

Montgomery Well, No. 4.

	Feet.		Feet.
First Cow Run Sand	710	to	730
Cave	890		
Second Cow Run Sand (oil, 1155)	1145	"	1165
Salt Sand (Maxton)	1660	"	1690
Big Injun Sand (water, 1755′)	1740	"	1920
Berea Grit (gas, 2250′)	2249	"	2260
Bottom			2266

Montgomery Well, No. 5.

	Feet.		Feet.
First Cow Run Sand (oil)	750	to	780
Second Cow Run Sand (oil)	1210	"	1255
Salt Sand (Maxton) (water and oil)	1690	"	1720
Big Injun Sand	1800	"	1980
Berea Grit	2317	"	2326

J. Brown Well, No. 1.

Union district. Authority, South Penn Oil Company.

	Feet.		Feet.
Second Cow Run Sand	1100	to	1135
Berea Grit (gas, 2212′)	2208	"	2220
Bottom			2225

Gribble Well, No. 1.

Union district. Authority, United States Oil Company. Ogdin pool.

	Feet.		Feet.
First Cow Run Sand	960	to	980
Second Cow Run Sand	1280	"	1300
Salt Sand (oil, 1500′)	1500	"	1550
Big Injun Sand (show oil, 1850′)	1820	"	1955
Berea Grit (oil and gas, 2315′)	2315	"	2322½
Bottom of well			2332

Pollock Well, No. 5.

Near Waverly. Authority, Crawford & Wilson.

			Feet.
Casing ten-inch			480
Casing eight and one-fourth-inch			1230
Casing six and five-eighths-inch			1957
Cow Run Sand	1100		
Big Injun Sand	1800	to	1957
Berea Sand	2302	"	2310

The records of J. B. Hendershot wells Nos. 1 and 2 which opened the Hendershot pool, six to eight miles south from Waverly, is given in Vol. I, pages 292-4.

The following is the record of No. 3 well on the same farm:

J. B. Hendershot Well, No. 3.

Hendershot field. Authority, South Penn Oil Company.

	Feet.		Feet.
Dunkard Sand	1168	to	1204
Salt Sand	1500	"	1690
Big Injun Sand	1690	"	1908
Berea Sand	2240	"	2250
Bottom			2259
(Dry.)			

The driller has made no distinction here between the Salt Sand, Big Lime and Keener horizons.

Eschenbacker Well, No. 2.

Hendershot pool. Authority, U. S. Oil Company.

	Feet.		Feet.
Cow Run Sand	1095	to	1140
Gas Sand (water, 1410′)	1400	"	1440
Salt Sand (oil show)	1540	"	1600
Big Injun Sand (water, 1710′)	1690	"	1890
Berea Grit	2217	"	2227
Bottom			2332
Ten-inch casing	265		
Eight and one-fourth-inch casing	1095		
Six and five-eighths-inch casing	1890		

Eschenbacker Well, No. 3.

	Feet.		Feet.
Cow Run Sand	1155	to	1185
Salt Sand	1500	"	1580
Big Injun Sand (water)	1822	"	1940
Berea Grit	2291	"	2302
Bottom			2314

McPeak Well, No. 1.

Hendershot field. Authority, U. S. Oil Company.

	Feet.		Feet.
Cow Run Sand (water, 1128′)	1108	to	1160
Salt Sand (water, 1450′)	1440	"	1460
Maxton Sand	1640	"	1700
Big Injun Sand (water, 1740′)	1725	"	1900
Berea Grit	2233½	"	2240

McPeak Well, No. 2.

	Feet.		Feet.
Red cave	870		
Black cave	1115		
Cow Run Sand (water, 1160′)	1140	to	1280
Salt Sand	1480	"	1495
Keener (Maxton?) Sand	1680	"	1740
Big Injun Sand (water, 1770′)	1760	"	1920
Berea Grit (oil and gas, 2268′)	2264	"	2273

McPeak Well, No. 3.

	Feet.		Feet.
Cow Run Sand	1030	to	1070
Salt Sand	1400	"	1480
Maxton Sand	1600	"	1660
Big Injun Sand	1700	"	1850
Berea Grit (gas and oil, 2200′)	2200	"	2211
Ten-inch casing	230		
Eight and one-fourth-inch casing	1040		
Six and five-eighths-inch casing	1850		

Ruth Wharton Well, No. 1.

Hendershot pool. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1005	to	1025
Salt Sand	1150	"	1400
Maxton Sand	1520	"	1560
Big Lime	1560	"	1625
Big Injun Sand	1625	"	1830
Berea Grit	2116		
Total depth			2144

The sand usually termed "Cow Run" in these records, is in most cases the Second Cow Run Sand.

Ruth Wharton Well, No. 2.

	Feet.		Feet.
Cow Run Sand	1090	to	1130
Salt Sand, Maxton	1560	"	1670
Big Injun Sand	1750	"	1930
Berea Grit	2215	"	2228
Total depth			2242

Dye Well, No. 1.

Hendershot field. Authority, United States Oil Company.

	Feet.		Feet.
Red cave	850		
Black cave	1000		
Cow Run Sand	1045	to	1080
Salt Sand (water, 1380′)	1380	"	1425
Maxton-Keener Sands (water, 1575′)	1555	"	1615
Big Injun Sand (water, 1625′)	1625	"	1825
Berea Grit (oil)	2170	"	2184
Ten-inch casing	200		
Eight-inch casing	1045		
Six and five-eighths-inch casing	1825		

Charles Shattuck Well, No. 19.

Hendershot Pool. Authority, South Penn Oil Company.

	Feet.		Feet.
Limestone	92	to	112
Red cave	880	"	890
Red rock	940	"	1000
Sand (water)	1540	"	1620
Keener and Big Injun Sands	1840	"	1995
Lime, hard	2095	"	2145
Berea Sand	2333		
Bottom	2335		

Charles Shattuck Well, No. 20.

Hendershot field. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1170	to	1190
Salt Sand	1430	"	1480
Maxton Sand	1760	"	1775
Big Injun Sand	1800	"	1924
Berea Sand (oil)	2272	"	2284
Bottom			2298

A. B. Wharton Well, No. 1..

Hendershot Pool. Authority, South Penn Oil Company.

	Feet.
Berea Sand	2117
Total depth	2153

Elgie Grant Well, No. 1.

Hendershot Pool. Authority, South Penn Oil Company.

	Feet.		Feet.
Berea Grit (oil, 2238′)	2230	to	2243
Total depth			2254

Elgie Grant Well, No. 2.

	Feet.		Feet.
Cow Run Sand	1095	to	1115
Salt Sand	1300	"	1435
Maxton Sand			1635
Big Injun Sand	1720	"	1910
Berea Grit	2236	"	2251
Bottom			2263

Elgie Grant Well, No. 3.

	Feet.		Feet.
Berea	2281	to	2292
Depth			2315

Elgie Grant Well, No. 4.

	Feet.		Feet.
Cow Run Sand	1028	to	1058
Salt and Maxton Sands	1408	"	1648
Big Injun Sand	1648	"	1848
Shell			2128
Berea	2143	"	2156
Total depth			2171

Joshua Burge Well, No. 1.

Short distance north from Northwestern Turnpike and one-half

to three-fourths of a mile westerly from Murphytown, Clay district. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Conductor		10
Red shales	140	150
Sand (10″ casing, 245′)	25	175
Slate, light thin shells, sand and lime	375	570
Lime and shells	5	575
Sand	25	600
Red cave, etc.	200	800
Slate and shells	130	930
Sand (8¼″ casing, 940′)	30	960
Slate, dark	50	1010
Sand (little water, oil show, 1040′)	105	1115
Slate	130	1245
Salt Sand (little water)	95	1340
Slate, dark, occasional shells	145	1485
Sand (salt water, 1555′)	80	1565
Slate	25	1590
Sand (very soft, white; 6¼″ casing, 1625′)	35	1625
Big Lime, white	45	1670
Sand, Big Injun (water, 1710-15′)	90	1760
Slate, shells (5″ casing, 1810′)	115	1875
Lime, white, sandy	10	1885
Slate, shelly	245	2130
Slate, black	20	2150
Shells, place of Berea	10	2160
Slate to bottom	205	2365

J. D. Walker Well, No. 6.

Murphytown. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1165	to	1195
Salt Sand			1470
Big Injun Sand	1700	"	1949
Berea Grit			2301
Total depth			2327

John Alleman Well, No. 1

Murphytown. Authority, South Penn Oil Company.

	Feet.		Feet.
Berea Sand	2192	to	2200

John Alleman Well, No. 2.

	Feet.		Feet.
Dunkard Sand	1180	to	1210
Salt Sand	1420	"	1550

Big Injun Sand	1750	"	1950
Berea Oil at	2293		
Total depth			2311

John Alleman Well, No. 5.

	Feet.		Feet.
Cow Run Sand	1172	to	1202
Salt Sand	1457	"	1630
Big Injun Sand	1720	"	1935
Berea Sand	2292	"	2299
Total depth			2311

Susan Grant Well, No. 2.

Murphytown. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1180	to	1190
Salt Sand	1200		
Maxton Sand	1605	"	1640
Big Injun Sand	1710	"	1870
Berea Sand (oil, 2247′)	2242	"	2254

Susan Grant Well, No. 3.

	Feet.		Feet.
Cow Run Sand	1095	to	1122
Salt Sand	1296	"	1635
Maxton Sand	1635	"	1715
Big Injun Sand	1725	"	1910
Berea Sand	2230	"	2262

D. C. Farrow Well, No. 1.

Murphytown. Authority, South Penn Oil Company.

	Feet.		Feet.
Cow Run Sand	1141	to	1211
Salt Sand	1400		
Big Injun Sand	1680	"	1870
Berea Grit	2266		
Total depth	2285		

W. H. Compton Well, No. 1.

About three miles above Williamstown, near river. Authority, South Penn Oil Company.

	Feet.		Feet.
Lime	36	to	51
Red rock	51	"	128
Coal	128	"	133
Lime	233	"	248
White slate	248	"	275
Lime	275	"	305
Red rock	305	"	325
Lime	325	"	335

Red rock	335	"	350
White slate	350	"	370
Red rock	370	"	400
Lime	400	"	415
Red rock	415	"	450
White slate	450	"	470
Lime	470	"	495
Red rock	495	"	550
Lime shale and sand	550	"	580
Red rock	580	"	610
White slate	610	"	630
Black slate	630	"	645
Lime	645	"	670
Pale red rock	670	"	705
First Cow Run Sand	705	"	735
White slate	735	"	771
Second Cow Run Sand	771	"	813
White slate	813	"	833
Sand	833	"	853
Shale	853	"	883
Sand	883	"	976
Slate	976	"	1000
Sand	1000	"	1090
Slate	1090	"	1150
Sand	1150	"	1210
Slate	1210	"	1260
Sand	1260	"	1335
Slate, shell	1335	"	1405
Big Injun Sand	1405	"	1605
Black slate	1605	"	1615
Slate	1615	"	1705
Sand	1705	"	1717
Hard shell	1717	"	1719
Black shale	1719	"	1737
Berea Sand	1918	"	1920
Total depth			1948

M. W. Athey Well, No. 1.

One mile and a half south of Williamstown. Authority, South Penn Oil Company.

	Feet.		Feet.
White sand	230	to	260
Sand	520	"	530
Coal (?)	550	"	558
Red rock	600	"	700
Cow Run Sand	818	"	840
Salt Sand	970	"	1046
Shale and shells	1046	"	1435

Broken Sand (Maxton?)	1435	"	1457
Keener Sand	1490	"	1520
Big Injun Sand (gas, oil and water, 1588′)	1520	"	1673

Greer Well, No. 1.

Near Vienna Station, four miles north of Parkersburg. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded	790	790
Cow Run Sand (oil, 794′; water, 840′; oil, 870′)	106	896
Unrecorded	49	945
Sand	20	965
Unrecorded	75	1040
Salt Sand	16	1056
Unrecorded	314	1370
Big Lime	30	1400
Big Injun Sand (gas, 1420′ and 1507′; water, 1498′)	203	1603
Unrecorded (5¼″ casing, 1633′)	268	1871
Black slate	28	1899
Slate and pebbles ("cap")	2	1901
Berea { Good sand 8′ / slaty sand 5′ }	13	1914
Unrecorded to bottom	10	1924

Elias McPherson Well, No. 1.

One-half mile northeast from Red Hill Postoffice, and six miles due east of Parkersburg. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Conductor		10
Red and lime shells	190	200
Sand, soft, white	25	225
Coal (Washington?)	5	230
Red and lime shells, thin	115	345
Slate, light and dark shells	155	500
Sand	50	550
Slate, gray and soft	110	660
Sand	15	675
Red sand, varying light and dark	165	840
Sand	30	870
Lime	30	900
Sand (water)	35	935
Slate, black	30	965
Shell, limy (oil, smell)	15	980

Slate, dark	25	1005
Slate, white	25	1030
Shells	20	1050
Slate	70	1120
Sand	20	1140
Slate	35	1175
Slate, dark and light	35	1210
Sandstone, dark gray	20	1230
Shells	80	1310
Sand (water, 1320′)	50	1360
Shells and slate, dark	115	1475
Slate	25	1500
Sand, light, little water	30	1530
Sand, dark	10	1540
Slate	25	1565
Sand, limy (water, 1590′) (Maxton)	40	1605
Big Lime	50	1655
Sand (Keener)	15	1670
Slate	60	1730
Sand, dark (Big Injun)	15	1745
Slate	10	1755
Sand, dark and impure	15	1770
Slate (occasional thin shell)	.70	1840
Lime (shell, sandy, very hard	5	1845
Slate, thin shells	100	1945
Shells	5	1950
Slate	20	1970
Shell (oil smell)	5	1975
Slate	150	2125
Slate, black	30	2155
Shells (place of Berea)	25	2180
Slate, light, to bottom	93	2273

Marsh Well, No. 1.

Slacktown, four miles east of Parkersburg. Authority, John F. Carll.

	Thickness. Feet.	Depth. Feet.
Conductor		30
Shells and sand (water, 115′)	90	120
Shale, black	115	235
Red rock	165	400
Shale, black	75	475
Sand	15	490
Red rock	125	615
Shale, black	65	680
Lime, shells	20	700
Red rock	190	890

Cow Run Sand (water, 900 to 910′)......	110	1000
Slate, black	40	1040
Sand, hard	25	1065
Slate, black	40	1105
Sand	20	1125
Slate, black	10	1135
Sand	40	1175
Slate, black	125	1300
Limy sand	105	1405
Big Injun { sand, yellow and hard. 90′; sand, black and soft. 115′ }	205	1610
Sand, black and soft	115	1725
Slate and shell (cased, 1725′)...........	80	1805
Clear shale	196	2001
Berea (only shells)	13	2014
Shale	216	2230

Lubec and Lehman Well.

On Deval Farm, Tygarts district. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded		690
Shale, black	160	850
Sand (salt water)	110	960
Shale, black	60	1020
Sand, white	15	1035
Shale, blue	25	1060
Sand, white	35	1095
Shale, black	20	1115
Sand, white	15	1130
Shale, black	20	1150
Sand, white	50	1200
Shale, black	60	1260
Salt Sand	110	1370
Shale	20	1390
Big Lime	10	1400
Sand, gray (Keener).....................	40	1440
Slate	5	1445
Big Injun { Sand, gray .... 45′; Sand, white.........145′ }	190	1635
Sand, gray	115	1750
Shale, blue	150	1900
Shale, blue (cable measurement, 1936′; wire, 1943′)	43	1943
Sand (gas and oil) Berea................	6	1949
Slate, black	271	2220
Sand, dark	25	2245

Shale, black to bottom	755	3000

Poling Farm Well, No. 1.

Near Chesterville. Authority, Miller & Sibley.

	Thickness. Feet.	Depth. Feet.
Conductor	14	14
Unrecorded	161	175
Sand	30	205
Unrecorded	330	535
Sand	15	550
Unrecorded	150	700
Sand	15	715
Unrecorded (oil in shell at 870′)	243	958
Sand	20	978
Unrecorded	40	1018
Sand, Big Cow Run (Water, 1090′ and 1165′)	150	1168
Unrecorded	67	1235
Sand	25	1260
Unrecorded	10	1270
Sand	61	1331
Unrecorded	25	1356
Sand	56	1412
Slate	78	1490
Big Lime	80	1570
Big Injun Sand	105	1675
Lime, break	10	1685
Big Injun Sand	48	1733
Lime, gritty	67	1800
Slate and shells	347	2147
Black shale	25	2172
Shells, place of Berea	...	....

WIRT COUNTY WELL RECORDS.

Wirt county has Wood for its northwestern boundary, and Calhoun on its southeastern border.

As already related in Chapter I, the first oil well in the state to be drilled solely for oil was sunk near Burning Springs in this county, and obtained a good flow of oil in one of the numerous "Cow Run Sands," so that Wirt was the first county in West Virginia (then Virginia) to produce oil in large quantity. Burning Springs in this county got its name from natural gas which issuing from the ground in a pool of water made by a spring, would flash into a flame when a lighted match or torch was held

over the escaping gas. The "Spring" was near the crest of the great arch in the rocks which coming down from the southwest along the valley of Spring creek, in a low broad swell, suddenly rises into a very pronounced fold with steeply dipping sides, to continue on north about 11° east through Volcano to the Ohio river near Eureka. The early oil operations followed closely the crest of this uplift, the first producing well on the Rathbone tract being located near the axial line of the same where a 100 barrel well was secured at a depth of 303 feet, in the Dunkard Sand.

The Roberts Brothers drilled a well through all of the Venango group of Sands in this region, and as its top begins only 25 feet below the Ames (Green Crinoidal) Limestone, and its underlying Friendsville coal, its record is of much interest in fixing the exact geological horizons of the producing oil sands in the Burning Springs region. It reads as follows:

Record of Roberts Well, No. 1.

Near Burning Springs.

	Thickness. Feet.	Depth. Feet.
Conductor and **red shale**	60	60
Limestone, very hard	6	66
Red and blue shales	69	135
Sand (water and paraffine)	10	145
Blue shales, soft	99	244
Sand, **Dunkard, (Mahoning)** good show of oil (Cow Run?)	71	315
Gray and blue shales	57	372
Sand	31	403
Shale	33	436
Sand, gray, shelly, **oil show at base** ("Gas Sand," Second Cow Run?)	55	491
Shale, gray	79	570
Sand	60	630
Shale, blue and gray	118	748
"**Salt Sand,**" upper member, good gas flow (2,500,000 feet)	58	806
Shale	14	820
"**Salt Sand,**" lower member, **Cairo** or **Maxton Sand**	110	930
Limestone, ("Big Lime") very hard, lower half mixed with sand	115	1045
"**Big Injun**" Sand, **fair oil show**	50	1095
Shale, gray	385	1480

Black shale, mixed with sand (**"Berea"**) and showing **oil**	10	1490
Shale, gray	385	1875
Black shale, lower half mixed with **sand** (**"Gordon"**) showing **oil**	15	1890
Shale, very soft in lower portion to bottom of well	120	2010

The sand at 244 feet is the one into which the first well was drilled in 1860, and would appear to be the Dunkard Sand (Mahoning) of Pennsylvania. The rest of the section speaks for itself, except that probably the lower half of the "Big Lime" should be included in the Big Injun Sand below.

Near Burning Springs village a well drilled into the Big Injun Sand secured a fair flow of oil in its top. It is known as the Keener Sand well, and its record is as follows, according to Roberts Bros.:

Keener Well, on Rathbone Tract.

Elevation above creek level 60 feet.

	Feet.		Feet.
Cow Run Sand (Dunkard)	272	to	349
Thirty-foot Sand	401	"	432
Five-hundred-foot Sand	473	"	530
Gas Sand	600	"	660
Salt Sand (Maxton, Cairo)	777	"	960
Big Lime	960	"	1060
Keener Sand	1060	"	1083
Big Injun Sand	1088	"	1128

Rathbone Tract.

"Five Hundred-Foot" Well.

Near Burning Springs. Authority, Roberts Bros.

Elevation above creek 56 feet.

	Feet.		Feet.
Second Cow Run Sand (Dunkard)	206	to	278
Thirty-foot Sand	330	"	361
Five-hundred-foot Sand	407	"	470

Rathbone Tract.

Second Cow Run Sand Well.

Near Burning Springs. Authority, Roberts Bros.

Elevation above creek 150 feet.

	Feet.		Feet.
Second Cow Run Sand	356	to	428

The following record was kept with much care by the late Prof. F. W. Minshall of Marietta, Ohio, and is important as showing the presence of several coal beds below the surface. Mr. Minshall states that the well begins 70 feet below the Ames limestone, and hence between 300 and 350 feet below the horizon of the Pittsburg coal, the coal bed itself being absent from the measures nearly everywhere in Wirt:

Simpson Well, No. 1.

Devers Fork. Authority, F. W. Minshall.

		Thickness. Feet.	Depth. Feet.	
Cased at			83	
Shale, gray		35	118	
Coal		4	122	
Shales, dark		16	138	
Shale, gray		34	173	
Sand, dark, firm		23	196	
Sand, pebbly		11	207	
Shale, gray		13	220	
Coal (Mahoning)		4	224	
Shale, gray		16	240	
Sand, gray 3′				
Sand, white, coarse 6′				
Sand, white, finer 3′	Dunkard	48	288	
Sand, gray 28′				
Sand, white, fine 8′				
Coal, (Upper Freeport)		3	291	
Shale, gray		18	309	
Sand, gray		30	339	
Coal and clay (Lower Freeport)		6	345	
Clay and shales		5	350	
Shales, sandy		9	359	
Sand, gray (show oil) 10′	Second			
Sand, white and	Cow	29	388	Allegheny 232′
pebbly 19′	Run			
Shale, gray		52	440	
Coal and clay (Middle Kittanning)		5	445	
Shale, gray		9	454	
Sand		10	464	
Shale, gray		8	472	
Coal, (Lower Kittanning)		4	476	
Clay and lime		6	482	
Shale, gray		38	520	

Sand ....55′			
Shale, black ....90′			
Coal .... 5′			
Sand, gray .... 5′			
Shale, black ....28′			
Sand, gray, very hard.... 5′	Pottsville	330	850
Shale, black sand ....40′			
Sand .... 3′			
Shale, black.............59′			
Coal .... 1′			
Sand, white and pebbly..34′			
Sand, gray .... 5′			
Shale		10	860
Big Lime, white		60	920
Sand, Keener (gas at 925′) ....15′			
Lime ....15′			
Sand, gray, fine....20′			
Shales, light sandy. 5′			
Sand, gray and coarse ....23′	Big Injun Sand	135	1055
Sand, white and pebbly ....22′			
Sand, gray .... 8′			
Shales, black ...... 4′			
Sand, white, coarse and pebbly.....10′			
Sand, gray and soft.13′			
Shales, gray		10	1065
Shales		400	1465
Sand, gray, Berea		15	1480

William Dawson Well, No. 2.

Northeast corner of Wirt. Authority, South Penn Oil Company.

	Feet.		Feet.
Second Cow Run Sand	1330	to	1430
Gas Sand (gas, 1695′)	1690	"	1720
Small show oil at	1710		
Salt Sand (Oil, 1836 and 1854′) (Water, 1800′) (Three-barrel well.)	1781	"	1902

A. B. Wilson Well, No. 2.

Northeast corner of Wirt, Burning Springs district. Authority, South Penn Oil Company.

	Feet.		Feet.
Gas Sand (strong gas, 1650′)	1560	to	1675
Salt Sand	1687	"	1780

First pay	1740	"	1750
Second pay	1764	"	1780
Total depth			1795

(Ten-barrel well.)

McConaughey Well, No. 1.

One mile and a half southwest of Munday Postoffice, eastern edge of Wirt. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	277	to	282
Cave	427	"	552
Cow Run Sand	690	"	705
Cow Run Sand	835	"	895
Sand (gas, 1040′)	1035	"	1055
Salt Sand	1100	"	1150
Second Salt Sand	1170	"	1185
Third Salt Sand and Maxton (water and black oil, 1455′)	1435	"	1545
Pencil cave	1545	"	1560
Big Lime	1560	"	1678
Big Injun Sand	1678	"	1708
Berea Sand	2090	"	2115
Total depth			2205

Casto Well, No. 1.

On Tucker creek, 4½ miles due west of Elizabeth. Authority, Mr. Casto.

	Feet.		Feet.
Conductor, wood			16
Fresh water at			20
Salt water at			363
Ten-inch casing			395
Pittsburg Coal?	649	to	655
Second Cow Run Sand (8″ casing, 1020′)	1021	"	1101
Coal	1156	"	1160
Sand	1230	"	1345
Top of Big Injun Sand (hole full of water)	1715		
"Break"	1830	"	1860
Sand (6½″ casing, 1955′)	1860	"	1955
Hard Lime	1955	"	2055
Slate	2055	"	2240
Black chalk	2240	"	2265
Slate to bottom	2265	"	2380

W. J. McPhearson Well, No. 1.

One mile up Tucker creek from Morris Postoffice, and six miles west southwest of Elizabeth. Authority, Carter Oil Company.

	Feet.		Feet.
Pittsburg Coal	600	to	603
Cave	800	"	1025
Cow Run Sand (water, 1065′)	1025	"	1085
Salt Sand (water, 1800′)	1500	"	1870
Big Lime, sandy	1870	"	1920
Big Injun Sand (water, 1925′)	1920	"	1960
Total depth			2806
(Dry.)			

R. J. Moore Well, No. 1.

Near corner Wood, Wirt and Jackson counties, and nine miles west southwest of Elizabeth. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	600	to	825
Cow Run Sand	975	"	1015
Salt Sand	1500	"	1800
Big Lime	1800	"	1840
Big Injun Sand (water, 1840′)	1840	"	1880
Berea (shells)	2240	"	2252
Gordon Sand	2600	"	2608
Total depth			2802
(Dry.)			

The horizon of the Pittsburg coal would belong at about 530 feet in this well.

ROANE COUNTY WELL RECORDS.

Roane county lies directly south from Wirt and extends nearly to the Elk river.

The great Burning Springs arch rapidly flattens out southwestward from the Little Kanawha river, so that when it enters Roane along the valley of Spring creek the rocks dip away from its crest gently (40 to 50 feet to the mile) northward, while southward there is little or no reversal of dip, but a long rise to the south which steepens toward the southern end of the county. Hence geologic structure over a large portion of Roane is not favorable to the existence of either oil or gas in commercial quantity.

The southern portion of the county, or rather that south from Poca river, has more relief, in the shape of rapid dips to the northwest, and hence gives most promise of future development. Some good (three to five million feet) gas wells have

already been found in the Big Injun Sand on the waters of Sandy creek in southern Roane, and now supply Charleston with gas.

This gas field on Sandy creek has been developed by Mr. Fred Paul Grosscup, Superintendent of the Kanawha Natural Gas, Light & Fuel Company. The rock pressure is 600 pounds. No regular detailed logs of the wells were kept, but the gas sand was struck at about 1600 feet below the valley of Sandy creek on the Lewis and Geary lands. The surface rocks dip rapidly toward Walton, from the region of the gas wells, and since the gas has an oily odor, there must be an oil pool of considerable size somewhere down the slope of the strata.

Some gas wells and a few small oil wells have also been found ten to twelve miles southwest from Spencer in the Flat Fork region, and Spencer is supplied with gas from that locality. The wells are in the Big Injun Sand, and vary in size from one-third to three million feet. South from Richardson and six to seven miles east from Spencer some small (two to ten barrels) oil wells have been found in the Maxton Sand by the Carter Oil Company.

These three developments are all that Roane has yet found in the way of gas and oil production. The future should bring other and larger oil wells, but the search is likely to prove long and expensive.

The following well records will serve to exhibit the rock succession in the county:

The Carter Oil Company drilled a deep well on the Goff and Heck land, about one mile north from the Foltz pool of Maxton Sand oil, and three to four miles southeast of Triplett Postoffice. This record reads as follows, according to Mr. W. H. Aspinwall, of the Carter Oil Company:

Goff and Heck Well, No. 1.

	Thickness. Feet.	Depth. Feet.
Conductor		13
Lime	30	43
Slate	61	104
Sand	30	134
Red rock	66	200

Slate and red rock	200	400
Lime	40	440
Sand	40	480
Red rock	20	500
Lime	30	530
Red cave	30	560
Slate	140	700
Big red cave	90	790
Little Dunkard Sand	75	865
Black slate	35	900
White slate	35	935
Big Dunkard Sand	35	970
Slate	45	1015
Gas Sand	50	1065
Slate	25	1090
Sand	50	1140
Slate	30	1170
First Salt Sand	100	1270
Slate	10	1280
Second Salt Sand	60	1340
Slate	80	1420
Lime	40	1460
Slate	55	1515
Third Salt Sand (water, 1525′; show of oil, 1695′)	198	1713
Big Lime	87	1800
Big Injun Sand	80	1880
Slate and shells	280	2160
Lime	12	2172
Slate and shells	428	2600

S. F. Foltz Well, No. 1.

About one mile south of Goff and Heck well, and six miles east of Spencer. Authority, Carter Oil Company.

	Feet.		Feet.
Cave	525	to	875
Cow Run Sand	1020	"	1050
Salt Sand	1605	"	1720
Maxton Sand (oil)	1760	"	1786
Total depth			1790

Small producer in Maxton Sand.

S. F. Foltz Well, No. 6.

Authority, Carter Oil Company.

	Thickness. Feet.	Depth. Feet.
First Cow Run Sand (Mahoning)	75	1120
Slate	50	1170

Second Cow Run Sand	30	1200
Slate	20	1220
Lime	15	1235
Sand	45	1280
Slate, break	5	1285
Sand	87	1372
Slate	50	1422
Sand	58	1480
Slate	40	1520
Sand	18	1538
Lime	42	1580
Slate	70	1650
Lime	50	1700
Slate	48	1748
Sand (water, 1770 and 1820′)	105	1853
Slate	35	1888
Lime	38	1926
Maxton Sand	25	1951

"Maxton Sand, good, but no show of oil or gas."

David Simmons Well, No. 1.

Six miles east from Spencer. Authority, William Cale.

	Thickness. Feet.	Depth. Feet.
Conductor		16
Shale	20	36
Shale, blue (water at 40′)	10	46
Lime	10	56
Shale, blue	20	76
Shale, red	20	96
Lime	23	119
Shale, red	17	136
Sand	20	156
Shale, blue	10	166
Shale, red	65	231
Lime	5	236
Shale, blue	15	251
Lime	10	261
Shale, blue	16	277
Sand	41	318
Shale, blue	216	534
Red rock?	16	550
Shale, blue	10	560
Sand	40	600
Shale, blue	15	615
Sand	16	631
Slate, pink, hard	30	661
Slate, blue	5	666
Sand, white	15	681

Slate, white	10	691
Slate, brown	20	711
Slate, blue	34	745
Slate, brown	98	843
Sand	17	860
Slate, blue	20	880
Sand, gray	10	890
Slate	5	895
Lime	15	910
Shale, blue	12	922
Sand	93	1015
Shale, black	70	1085
Sand, white (cased at 1170′)	140	1225
Lime, black	5	1230
Coal	3	1233
Sand, black	15	1248
Lime, black	8	1256
Sand, white	5	1261
Lime, white	35	1296
Sand, white	12	1308
Slate, black	20	1328
Lime	27	1355
Sand, white	85	1440
Slate, black	15	1455
Lime, white	10	1465
Sand, white	35	1500
Sand, dark	20	1520
Slate and shells	50	1570
Lime, white	8	1578
Shale, black	12	1590
Limestone	15	1605
Sand, white (Maxton?)	85	1690
Sand, dark	3	1693
Slate, brown	7	1700
(Dry.)		

In the extreme eastern edge of Roane, bordering on Clay county, a well was drilled by the Elk River Oil & Gas Company on the Tallman farm, as follows:

P. A. Tallman Well, No. 1.

Authority, E. M. Hukill, President Elk River Oil & Gas Company.

	Feet.		Feet.
Sand	0	to	60
Red rock	60	"	560
Sand	560	"	580
Slate	580	"	585

First Cow Run Sand	585	"	670
Slate	670	"	675
Sand	680	"	775
Slate	775	"	790
Second Cow Run Sand	790	"	895
Slate	895	"	1045
Sand	1045	"	1085
Slate	1085	"	1165
Sand	1165	"	1212
Slate	1212	"	1335
Salt Sand	1335	"	1640
Slate	1640	"	1650
Little Lime	1650	"	1742
Pencil cave	1742	"	1752
Big Lime	1752	"	1837
Sand (Big Injun) (little gas)	1837	"	1838
Limestone	1838	"	1904
Slate	1904	"	1952
Conductor			27

Casing—Ten-inch, 80 feet; 8¼-inch, 580 feet; 6⅝-inch, 1752 feet.

In Vol. I, pages 264-5, the detailed record of a well at Spencer is given, to which the reader is referred.

CLAY COUNTY WELL RECORDS.

Clay county lies southeast from Roane, and extends eastward into the mountain region of the State, where, in the opinion of the writer, the chance of finding either oil or gas in paying quantity without an enormous expenditure of money in the search are very few indeed.

A few wells have been drilled in Clay, however, and the records of two of them follow:

J. M. Gross Well, No. 1.

Near Roane county line. Authority, E. M. Hukill, President, Elk River Oil & Gas Company.

	Feet.		Feet.
Conductor			18
Unrecorded (10″ casing, 24′)	18	to	35
Lime	35	"	125
Sand	125	"	128
Coal	128	"	130
Lime	130	"	175
Sand	175	"	325
Slate	325	"	360
Lime	360	"	400

Slate	400	"	473
Coal, Coalburg?	473	"	477
Lime ($8\frac{1}{4}''$ casing, 490′)	477	"	490
Slate	490	"	510
Sand	510	"	680
Slate	680	"	750
Sand	750	"	860
Slate	860	"	870
Sand	870	"	1022
Slate	1022	"	1040
Salt Sand	1040	"	1150
Slate	1150	"	1165
Sand (bottom of Salt Sand)	1165	"	1330
Red rock	1330	"	1333
Lime ($6\frac{5}{8}''$ casing, 1355′)	1333	"	1390
Slate	1390	"	1420
Big { Lime 105′, Slate (pencil) 5′, Lime 110′ }	1420	"	1640
Sand (Big Injun) (gas, 1650′)	1640	"	1680
Slate	1680	"	1690
Lime	1690	"	1775
Slate	1775	"	1890
Lime, shells and slate	1890	"	2340
Sand (Gordon?)	2340	"	2350
Slate	2350	"	2422

Harvey Sample Well, No. 1.

Elk river, half way between Clay and Clendenin. Authority, South Penn Oil Company.

	Feet.		Feet.
White slate	60	to	95
Coal (Coalburg?)	95	"	100
Gray sand	100	"	150
White slate	150	"	197
Coal	197	"	200
White slate	200	"	285
White sand	285	"	350
White slate	350	"	357
Coal	357	"	360
Gray sand	360	"	363
Black slate	363	"	425
Gray sand	425	"	440
Black slate	440	"	538
White sand	538	"	691
Black slate	691	"	730
White sand	730	"	757
Salt Sand	757	"	1035

Black slate	1035	"	1040
Black lime	1040	"	1050
White sand	1050	"	1115
Red rock	1115	"	1175
Lime	1175	"	1225
White sand	1225	"	1260
Sandstone and lime	1260	"	1300
White lime (Big?)	1325	"	1415
Big Injun Sand	1415	"	1507
Red rock	1507	"	1548
Gray sand	1548	"	1555
Slate, sand and shell	1555	"	1840
Black slate	1840	"	1890
White slate to bottom	1890	"	2614

"Two barrels per day from Big Injun Sand; well abandoned."

It is possible that the 50 feet of "Lime" at 1175 feet is the Big Lime and that the Sand at 1225 feet is the "Keener" Sand horizon, the Big Injun Sand being split up with limy deposits. It is possible that paying wells might be found by more drilling in this region. The well begins a few feet below the horizon of the Kanawha Black Flint.

The Kanawha formation extends to 730 feet, and the New river coarse white sandstones begin there and extends to 1115 feet.

The coal at 100 feet is probably the one mined at Clay, near the Elk river level.

JACKSON COUNTY WELL RECORDS.

Jackson county lies immediately west from Roane, and borders the Ohio river on the north. The rocks of this area are nearly horizontal, except for a gentle dip from the Ohio river southeastward into the center of a general syncline, the axis of which passes northeast and southwest nearly through the center of the county. Southeast of this axis (which is the main trough of the Appalachian basin) the rocks rise gently to the southeast. This very simple geologic structure is quite unfavorable for the accumulation of either oil or gas into rich pools, and hence when the *Sands* of the Jackson county region have been penetrated by the drill, a little oil, a little gas, and much water have been found in every well, and in nearly every *Sand*, but no oil or gas in commercial quantity, the *relief* evidently being too

slight to permit the separation of the three substances into *pools* of commercial value. Hence the future oil history of Jackson does not look bright viewed either by the result of several tests, or from a purely theoretical standpoint, although it is possible that future wells may find better results in some portion of its large untested area.

The record of a deep well drilled near Ravenswood is given in Vol. I, pages 283-4.

The following well records are from other portions of the county:

Sandyville Well.

Near Sandyville, four miles west of Roane county line. Authority, A. E. Fretts.

	Thickness. Feet.	Depth. Feet.
Conductor	20	20
Unrecorded	396	416
"Hurry Up" Sand	30	446
Unrecorded	104	550
Pittsburg Coal { coal, first vein.... 3′ slate ....40′ coal, second vein (Little Pittsburg) 2′ }	45	595
Unrecorded	240	835
Cow Run Sand	15	850
Unrecorded	125	975
Sand, mixed with black slate		
Unrecorded (cased in black slate at 1079′)	159	1134
Gas Sand (oil show at 1146′)	33	1167
Unrecorded	333	1500
Salt Sand (large flow of salt water)	120	1620
Unrecorded (cased 6″ at 1647′)	30	1650
"Big Injun" Sand (gas, water and a little oil at 1787 feet)—well not through "Big Injun" Sand at	137	1787

Henry Well.

Cottageville. Authority, Dan P. Gist. (Partial record.)

	Feet.		Feet.
Coal at	77		
First salt water	186		
First Cow Run Sand	650		
Second Cow Run Sand, bottom	971	to	1006
Thin coal	1011		

Coal	1021		
Coal	1023	"	1030
Salt Sand	1073	"	1111
Coal	1125	"	1126
Salt Sand	1158		
Black sand	1254		
Gray sand	1304		
White lime (Big)	1513	"	1613
Big Injun Sand	1613	"	1739
Berea Grit	2175		

Augusta Oil Company's Well.

In southeast corner Jackson, on Laurel run, southeast of Kentuck Postoffice. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded		280
First sand	65	345
Slate	72	417
Sand (water)	50	467
Red rock	123	590
Sand	25	615
Red rock	148	763
Red sand	37	800
White slate	110	910
Cow Run Sand (water)	130	1040
Black slate	70	1110
Sand	15	1125
Slate	40	1165
White Sand (fair show of oil)	60	1225
Black slate	25	1250
Sand	20	1270
Black slate	130	1400
Salt Sand	270	1670

"Big pressure gas at 1420 feet; show of oil at 1430 feet."

Casing 10-inch, 345 feet; 6¼-inch, 800 feet; 4⅞-inch, 1330 feet.

The Sand struck at 1400 feet, although holding much gas and some oil, was so filled with salt water that neither oil nor gas was available.

McClain Well, No. 1.

Near Kenna Postoffice. Authority, United States Coal & Oil Company.

	Feet.		Feet.
Gravel			12
Blue slate	12	to	40
Sand, light and water	40	"	50

Blue slate	50	“	90
Red shale	90	“	148
Light slate	148	“	212
Shale, red and shelly	212	“	304
Light slate	304	“	322
Lime, dark and hard	322	“	356
Light slate	356	“	366
Hard sand	366	“	388
Black slate	388	“	412
Light slate	412	“	422
Shale, red	422	“	432
Black slate	432	“	440
Light lime, hard	440	“	458
Slate, shelly	458	“	492
Slate and shells	492	“	532
Shale and red cave	532	“	572
Lime and shells	572	“	578
Shale and red cave	578	“	678
Light lime	678	“	684
Shale and red cave	684	“	704
Blue sand	704	“	729
Dark lime	729	“	734
Slate	734	“	750
Light sand	750	“	775
Shale, light	775	“	830
Shale, red	830	“	850
Slate, white	850	“	860
Lime, dark	860	“	900
Sand, light (8¼″ casing)	900	“	950
Slate, white	950	“	1020
Sand, white	1020	“	1065
Sand, light	1065	“	1100
Slate, light	1100	“	1112
Light lime, hard	1112	“	1145
Coal	1145	“	1150
Slate	1150	“	1168
Lime, very hard and white	1168	“	1232
Black slate	1232	“	1254
Lime, dark	1254	“	1312
Black slate	1312	“	1389
Light lime	1389	“	1456
Salt Sand (water, 1486′)	1456	“	1796
Black slate	1796	“	1800
Cased bottom Salt Sand	1800	“	1825
(Big) Lime, yellow and hard	1825	“	2000
(Big Injun) { Light sand, water..100′ Soft, white sand... 40′ Sand, hard and black .... 10′ }	2000	“	**2150**

Berea Grit? shell slight, some oil	2150	"	2185
Dark lime	2185	"	2215
Black slate	2215	"	2275
White slate	2275	"	2475
(Dry hole.)			

The driller identified the Sand at 1456 feet with the "Big Injun," but the writer suggests that it is the "Salt Sand" or Pottsville formation, and that the true "Big Injun" Sand which held some oil in its basal portion, was struck at 2,000 feet.

MASON COUNTY WELL RECORDS.

Mason county lies directly west from Jackson, and is bisected by the Great Kanawha river, which flows north through its center.

Geological structure and conditions are very similar in Mason to those in Jackson, and hence no productive wells of either gas or oil have yet been found, although some oil and gas occur in every well drilled, along with abundance of salt water, which has long been utilized near Hartford on the Ohio river in the manufacture of salt, the principal brines coming from the base of the Pottsville (Salt Sand), the top of the Big Injun Sand. The conclusion is unavoidable from the results of test wells and the known absence of prominent anticlinals in Mason, that few, if any, good pools of oil or gas can exist within the county.

Several test wells have been drilled near Letart, but none got oil or gas in paying quantity.

The following records will illustrate the rock succession in Mason:

Sterling Oil Company's Well, No. 10.

Near Letart. Authority, Dan P. Gist.

	Thickness. Feet.	Depth. Feet.
Drift	20	30
Sand	20	40
Red rock	60	100
White and red mud	85	185
White sand	5	190
Red rock	115	305
White sand	8	313
Dark slate	17	330

Trace coal (Pittsburg)	10	340
Light sandy shale	25	365
Light shale	40	405
Black shale	20	425
Red rock	191	616
Gray slate	39	655
Red rock	35	690
Hard black sand (1st Cow Run)	12	712
Flinty slate	20	722
Gray sand	3	725
Soft, white sand	15	740
Blue shale	15	755
White sand (salt water)	50	805
Blue shale	10	815
Brown and blue shale	25	840
Soft white sand	85	925
Blue shale	20	945
White sand (gas and salt water)	50	995
Blue shale	30	1025
Blue sand	15	1040
Limestone	20	1060
Gray sand	37	1097
Gray slate	8	1105
Black and gray slate	30	1135
White sand (salt water and gas)	35	1170
Blue shale	45	1215
Black shale	40	1255
Gray slate	30	1285
Soft, gray sand	20	1305
Black and blue shale	145	1450
Sandy shale	5	1455
Black slate	15	1470
White sand (salt water and gas)	60	1530
Big Lime	60	1590
Big Injun: Hard sand and gray slate 4′; Limestone 10′; Gray sand and lime 24′; Black slate 4′; Sand 10′; Blue sandy shale 21′; Black slate 4′; Sand with salt water 12′; Blue, sandy shale 15′; Gray sand with salt water 159′	263	1853
Blue slate	258	2111
Black slate	13	2124

Gray sand with salt water (Berea)	15	2139

C. S. Matson Well, No. 1.

Two miles from Point Pleasant. Authority, Prof. John F. Carll.

	Thickness, Feet.	Depth, Feet.
Surface		21
Sand	79	100
Slate, broken	166	266
Cow Run Sand (oil, gas and much water)	10	276
Break	54	330
Dunkard Sand (water)	75	405
Slate	195	600
Coal	8	608
Slate	1	609
Sand and slate (salt water, 710′)	126	735
Salt Sand (water, strong brine)	30	765
Sandstone and shells	200	965
Big Lime	100	1065
Slate	2	1067
Keener Sand	20	1087
Slate	20	1107
Big Injun Sand (water, little oil)	238	1345
Slate	295	1640
Berea Grit, good sand	30	1670
Slate to bottom	7	1677

Casing—Thirteen-inch, 21 feet; 10-inch, 100 feet; 8¼-inch, 510 feet; 6¼-inch, 720 feet; 4⅞-inch, 1320 feet.

Beech Hill Well.

One mile south of Brighton Postoffice, and seven miles southeast of Point Pleasant. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Slate and sand to		703
Slate	24	727
Salt Sand	67	794
Shale	116	910
Salt Sand	94	1004
White sand	86	1090
Big Lime	125	1215
Slate	100	1315
Sand 45′, Slate 90′, Sand and shale 75′, Oil sand (show of gas) 25′ — Big Injun	235	1550
Slate	265	1815
Sand, Berea, hard (show of oil)	25	1840

Slate to bottom	560	2400

Eight and one-fourth-inch casing, 170 feet; 6¼-inch casing, 680 feet; 4⅞-inch casing, 1580 feet.

PUTNAM COUNTY WELL RECORDS.

Putnam county lies directly south from Mason, and it is also bisected by the Great Kanawha river. In its northern half, geological structure and conditions are very similar to those in Mason, and hence no oil or gas in paying quantity has been found, although several test wells have been drilled. The southern portion of the county, however, extends southward to where the dip of the rocks begins to steepen quite rapidly, and hence in the portion of the county south from the C. & O. R. R. there is some chance for oil and gas, so far as geological structure is concerned. The succession of the strata in Putnam is shown by the following records of wells drilled in the different parts of the county:

Hurricane Oil Company's Well.

One mile south of Winfield. Authority, Prof. John F. Carll.

	Thickness. Feet.	Depth. Feet.
Unrecorded	1667	1667
Big Injun Sand (water)	95	1762
Slate and shell	372	2134
Berea Grit (smell of oil)	22	2156
Unrecorded to bottom	447	2603

Cargill Well.

Two miles south of Winfield. A. T. 597′. Authority, Jerome T. Boyer.

	Feet.		Feet.
Salt Sand, top	1127		
Big Lime, top	1421		
White Sand (Big Injun)	1628	to	1789
Lime	1915		
Slate	2115		
Sand (Berea)	2117	"	2271
Sand	2291		
Slate	2348		
Sand (Gordon?)	2385		
Slate	2405		
Slate and shells	2585		
Total depth	2603		

Red House Well.

Three miles north of Red House, on Beegum branch of Buffalo creek. Authority, Augusta Oil Company.

	Thickness. Feet.	Depth. Feet.
Unrecorded		1380
Salt Sand	230	1610
Black slate	10	1620
White Lime (Big)	173	1793
Black slate	27	1820
Big Injun { Sand (salt water at 1830′) ....50′; Black slate .... 5′; White sand ....20′ }	75	1895
Small show of oil		1875

Casing—Ten-inch, 145 feet; 8¼-inch, 475 feet; 6¼-inch, 998 feet; 4⅝-inch, 1875.

T. M. Harbour Well, No. 1.

Near Hurricane, in Teays Valley. Authority, Judge T. H. Harvey, President Hurricane Oil & Development Company.

	Feet.		Feet.
Gravel and quicksand	8		
Slate and red rock	55		
Sand	65		
Cave, rock and slate	290		
Cow Run Sand	325		
Slate	545		
Sand (2d Cow Run) water at	600	to	705
Coal	708		
Slate	725		
Sand (gas and water)	1025		
Slate	1045		
Gas Sand (water)	1245		
Slate	1260		
Salt Sand (water)	1465		
Big Lime	1578	"	1603
Keener Sand	1603		
Lime	1700		
Big Injun Sand (cased, 1828′)	1800		
Lime formation and slate	1800	"	2198

Berea Sand 22 feet thick; gas and oil neither in paying quantities.

CABELL COUNTY WELL RECORDS.

Cabell county lies west from Putnam and the southern point of Mason. It also borders the Ohio river, and hence its northern half has the same geological structure as Mason, in which no

paying oil or gas wells have yet been found. In the southern portion of the county, however, rapid dips set in, and the rocks acquire considerable *relief*.

A small but rich pool of oil was opened in October, 1903, by a well on the E. W. Beckett farm, two miles and a half southeast from Milton. This original well of the Milton field is located in the valley of Charley creek, a tributary of Mud river. It was drilled by the Cabell Oil & Gas Company, and the record of the well reads as follows, according to Mr. C. F. Cole, President, Walton Oil & Gas Company, who has kindly furnished the Survey much valuable information:

E. W. Beckett Well, No. 1.

Well mouth 602 feet above tide.

	Thickness Feet.	Depth Feet.
Sand, clay and gravel to		50
Red rock	30	80
Slate and fireclay	80	160
Blossom coal		160
Slate	20	180
White sand, show oil and water	12	192
Slate	68	260
Sand, making two bailers of oil per hour (Dunkard)	8	268
Slate	42	310
Sand, with water	20	330
Slate	45	375
Sand, with show of green oil and water to Bottom	45	420
Slate	55	475
Coal	7	482
Sand, with gas; water in bottom	18	500
Slate	144	644
Sand, showing black oil	30	674
Lime	16	690
Slate	39	729
Coal	3	731 (?)
Sand, showing black oil and gas	18	749
Slate	51	800
Sand	37	837
Slate	8	845
Sand	7	852
Slate	54	906
Sand	54	960

Lime	70	1030	
Sand, showing black oil, water, 25′ in sand	(157)	1157	
Slate	2	1159	
Sand, with water	103	1262	(?)
Lime (Big)	115	1378	
Sand ("Beckett SS") white, with oil and gas, hole filled 1200′ in 2 hrs; Oil Sand	15	1393	
Lime and sand to bottom	7	1400	
Lime, slate and shale to bottom	41	1441	

"Two hundred and forty-seven barrels first 24 hours. Making 50 to 60 barrels yet" (June 8, 1904).

The Sands with oil at 180 to 420 feet in this well represent the Mahoning, or Dunkard Sands of the northern portion of the State, and the great sandstone bluffs at Charleston, Kanawha county. The oil at 260 feet is of 46° gravity, and a beautiful reddish amber in color.

T. J. Berkeley Well, No. 1.

Two miles southeast of Milton, Cabell county, and one-fourth mile northeast of Beckett well, No. 1. Authority, C. F. Cole. Drilled by McCoach Oil Company. Well mouth 818 feet above tide.

	Thickness Feet.	Depth Feet.
Conductor	16	16
Slate	10	26
Sand	10	36
Red rock, slate, etc.	320	356
Sand (10″ casing)	10	366
Slate	60	426
Sand	10	436
Slate	24	460
Sand (Cow Run) show oil and gas	40	500
Slate	40	540
Unrecorded	120	660
Coal	3	663
Lime and slate	40	703
Sand	80	783
Slate, lime, etc.	265	1048
Slate	32	1080
Sand, water, 1114′	80	1160
Lime	70	1230
Black sand	60	1290
Salt Sand	156	1446

Sandy lime and pebbles ($8\frac{1}{4}''$ casing)....	44	1490
Lime, white and hard..................	102	1592
65′ in lime a little gas and very small pebbles.		
Sand	12	1604
Still sand and all looks alike without a break. Most gas about 10′in.		
Bottom		1619
Pay at 1595.		

"This well came in, December, 1903, and has produced over 10,000 barrels. Made over 2,000 barrels for January, 1904. Casing collapsed in shooting, but the well was finally opened up again June 7, 1904, when it made 50 to 60 barrels daily."

There has been much discussion among the oil fraternity as to whether the oil horizon of these wells is in what corresponds to the Keener Sand (top of the "Big Injun") or really in the "Big Lime" entirely above the Keener division of the Injun. It will be remembered that the entire Big Injun formation is often invaded by limy beds, and hence it is most probable that the Beckett, Berkeley and other wells in the Milton field get their oil from what corresponds to the "Keener" Sand of Tyler, and the top of the Big Injun in Marion and Monongalia. True, the oil is dark in color, and the gravity only $40\frac{1}{2}$ to 41°, but all oils in limy beds are dark in color and not high in gravity.

C. E. Burns Well, No. 1.

Three-eighths of a mile southwest of E. W. Beckett well, No. 1. Drilled by Charley Creek Oil & Gas Company. Authority, C. F. Cole. Well mouth 649 feet above tide.

	Thickness Feet.	Depth Feet.
Clay	30	30
Sand	57	87
Slate	53	140
Sand, with oil	10	150
Slate and fireclay......................	58	208
Sand	12	220
Slate	15	235
Lime	10	245
Slate	45	290
Sand (oil and salt water)...............	18	308
Slate	72	380
Coal	3	383
Sand, salt water	102	485

Slate	9	494
Coal	3	497
Slate	16	513
Sand, water to drill	27	540
Slate	15	555
Sand	31	586
Slate	2	588
Sand, with water	28	606
Slate and shale	109	715
Slate	20	735
Sand	40	775
Slate	25	800
Sand with water	70	870
Slate, black	46	916
Sand with little gas	2	918
Sand with heavy gas	17	935

Gas at 918′.

"Makes 2,300,000 cubic feet daily. Gas is utilized for lease work. Well drilled no deeper."

The gas sand in this well is the one struck in the E. W. Beckett well, No. 1, at 906 feet, and is evidently a portion of the Pottsville formation.

Blake Well, No. 1.

Two and one-half miles north 60° east of Milton, Cabell county, on branch of Kilgore creek. Drilled by Teays Valley Oil and Gas Company. Authority, C. F. Cole. Well mouth 620 feet above tide.

	Thickness Feet.	Depth Feet.
Conductor	20	20
Blue and gritty	30	50
Red rock	30	80
Slate and shell	75	155
Sand	40	195
Slate, lime and shells	85	270
Sand (10″ casing, 280′)	10	280
Slate	40	320
Sand, with water	20	340
Slate	35	375
Slate and shells	25	400
Sand, with show of oil	20	420
Slate	25	445
Sand, with water	55	500
Slate and shell	35	535
Sand, more water	190	725
Slate (8″ casing, 735′)	9	734

Sand	286	1020
Coal (1′ of slate above and below)	2 + 5	1027 (?)
Sand, with water	223	1250
Slate and lime with shells (cased at 1260′)	70	1320
Soft lime, black and yellow	61	1381

"This well was drilled to 2300 feet. and is dry in all sands."

Walton Well, No. 1.

Three miles east of Milton, and one-half mile northwest of Culloden. Authority, C. F. Cole, President and General Manager of the Walton Oil & Gas Company. Well mouth 729 feet above tide.

	Feet.
Conductor	12
Clay	72
Sand	70 (?)
Black slate	95
Red rock	210
Sand	235
Slate and red rock	313
Sand	345
Slate	370
Sand	400
Slate	405
Lime	413
Slate	430
Shale	447
Sand	465
Slate	545
Sand, with water	615
Slate	630
Sand	655
Slate	670
Sand, more water	795
Slate	820
Sand, with gas	850
Shale	900
Sand	930
Coal	934
Shale	1000
Shale, little water	1065
Sand, with gas 3′ in	1343
Black sand, with streak lime	1390
Black slate	1430
Sand	1460
Top Big Lime	1460
Gas at	1520
Little water under gas.	
First show oil	1577

Second show oil	1597
Bottom Lime	1630
Slate and shale	1665
Top Big Injun Sand	1685
Water	1693
Bottom of Big Injun Sand	1770
Slate and shell to	1900
Dark gray sand	1970
Black gray sand	2030
Slate and sand	2140
Slate	2175
Soft black shale	2180
Top of Berea / Gas 8′ in Berea / Slate and Berea	28′ 2188 to 2208
Slate and shell to bottom	2238

"Fair gas well in Berea."

J. A. Reese Well, No. 1.

One mile and a quarter southeast of Milton, and the same distance northwest of E. W. Beckett well, No. 1. Drilled by Va-Ken-O Oil & Gas Co. Authority, C. F. Cole. Well mouth 630 feet above tide.

	Thickness Feet.	Depth Feet.
Soil	4	4
Sand, hard	96	100
Slate	15	115
Red rock (10″ casing, 143′)	28	143
Blue slate	14	157
Lime shells	12	169
Red rock	10	179
Lime shells	10	189
Lime, hard	10	199
Slate	7	206
Lime, shell	4	210
Lime, shell, broken	10	220
Lime, hard	10	230
Slate, blue	12	242
Lime	5	247
Sand	12	259
Sand	12	271
Slate, red	6	277
Shale, white	6	283
Sand, white and hard	15	298
Red shale	7	305
Lime, shells	10	315

White sandy shale		29	344
White slate		30	374
Blue slate		10	384
Lime		14	398
Sandstone, broken		12	410
Slate		40	450
White sandstone, top pebbly (Traces of water at bottom.)		45	495
Sand, gray (8¼″ casing)		8	503
Slate		15	518
Slate		24	542
White sand		40	582
Slate white and black		44	626
Coal		6	632
White sand, water enough to drill with		26	658
Black slate		40	698
Sand, gray		65	763
Sand white, water, 10 bailers per hour		48	811
Black slate		76	887
Sand, white		40	927
Black slate		12	939
Sand, white		35	974
Lime		6	980
Sand, white		10	990
Black slate		15	1005
Sandy shale		10	1015
Lime shells		7	1022
Black slate		40	1062
White sand full of water....92′			
Black slate ....3′			
White sand ....60′			
Black slate ....95′	Salt Sand	331	1393
Limy shells ....83′			
Black slate ....5′			
Lime, flinty ....20′			
White sand ....63′			
Sand, black hard and limy		100	1493
Big Lime, white		16	1509
Strong flow of gas			1511
Bottom of Big Lime			1556
White sandy grit		40	1596
White slate		15	1611
Black slate		10	1621
Gray Pebbly Sand (where Keener should be)		36	1657
Black slate		24	1681
Big Injun Sand (show of oil 1696′; hole filled with water 1707′)		95	1776
Black slate		8	1784
White Sand (Probably Squaw)		5	1789

Black slate	109	1898
White sand	9	1907
Black slate.	293	2200
Berea Sand (flow of gas on top)	23	2223
Bottom of hole	3	2226

"This has been a volume of 800,000 cubic feet per day from the Berea Sand, with a rock pressure of 600 pounds per square inch."

W. W. Connor Well, No. 1.

Two and one-half miles southeast of Milton, on the west bank of Charley creek. Drilled by the Cabell Oil & Gas Company. Authority, H. M. Stanbery, Chief Engineer, Carter Oil Company. Well mouth 585 feet above tide.

	Feet.		Feet.
Conductor			93
Slate	93	to	96
Sand (show of oil)	96	"	97½
Slate	97½	"	106
Coal	106	"	110
Slate	110	"	160
Sand (pebbles, show oil)	160	"	162
Slate	162	"	350
Sand (Hurry Up, Upper and Lower Mahoning, First Cow Run)	350	"	456
Gray Sand	456	"	532
Sand	532	"	606
Slate	606	"	610
Coal	610	"	618
Gray Sand, very hard (2d Cow Run)	618	"	750
Sand (water, 790′)	750	"	800
Gray Sand, hard (gas)	800	"	850
Sand (salt water)	850	"	1050
Slate	1050	"	1055
Coal and slate	1055	"	1075
Lime	1075	"	1105
Hard, white sand	1105	"	1250
Slate	1250	"	1260
Big Lime	1260	"	1380
Sand (Keener, show of oil)	1380	"	1415
Gray shale	1415	"	1513
Sand (Big Injun) (gas)	1513	"	1621
Slate	1621	"	2025
Sand (Berea) gas	2025	"	2052½
Slate and shells to bottom	2052½	"	2776

Gas well in Berea; capacity, 750,000 cubic feet. The record of this same well given by Mr. Joseph Touner, the driller, is

slightly different from Mr. Stanbery's, as shown by the following:

W. W. Connor Well, No. 1.

Authority, Joseph Touner.

	Feet.		Feet.
Sand	244	to	350
Unrecorded	350	"	458
Sand	458	"	532
Unrecorded	532	"	700
Sand	700	"	750
Unrecorded (water, 790′)	750	"	800
Gray sand (gas)	800	"	850
White sand (water)	850	"	1050
Unrecorded	1050	"	1215
Lime (show oil and gas, 1380′)	1215	"	1415
Unrecorded	1415	"	1507
Big Injun (show oil and gas)	1507	"	1615
Unrecorded	1615	"	2020
Berea Grit (gas)	2020	"	2048
Shells and slate	2048	"	2780

(Good gas well from Berea.)

W. W. Connor Well, No. 2.

Two and three-fourths miles southeast of Milton, near mouth of Charley creek. Drilled by the Cabell Oil & Gas Company. Authority, Joseph Touner. Well mouth 595 feet above tide.

	Feet.		Feet.
White sand (show of gas and oil)	300	to	330
Unrecorded	330	"	360
Sand (water)	360	"	440
Black sand	440	"	455
Unrecorded	455	"	600
White sand	600	"	650
Unrecorded	650	"	720
White sand	720	"	760
Unrecorded	760	"	925
White sand	925	"	1125
Pebble sand (show oil and gas)	1100	"	1130 (?)
White sand (water)	1170	"	1270
Unrecorded	1270	"	1315
Big Lime (show oil and gas)	1315	"	1403
Unrecorded	1403	"	1550
Big Injun Sand (water to drill)	1550	"	1640
Slate and shells	1640	"	2050
Berea Grit (good gas)	2050	"	2080
Slate and shells	2080	"	2150

J. D. Carter Well, No. 1.

Near Milton. Drilled by the Cabell Oil & Gas Company. Authority, Joseph Touner, per W. H. Aspinwall, of Sistersville. Well mouth 601 feet above tide.

	Feet.		Feet.
Gravel, slate and sand	0	to	655
Coal blossom	655	"	655
Slate and sand	655	"	717
Coal	717	"	720
White sand	720	"	746
Black slate	746	"	754
Shells, slate and sand	754	"	835
Slate	835	"	872
Sand (gas)	872	"	882
Red? rock	882	"	892
Sand (water 902′)	892	"	1013
Slate and shells	1013	"	1031
Lime	1031	"	1120
Slate	1120	"	1132
Sand (water, 1167′)	1132	"	1245
Slate	1245	"	1250
Big Lime (show of oil and gas, 1350′ and 1400′	1250	"	1425
Slate	1425	"	1462
Big Injun { Sand 33′; Slate 25′; Sand (water, 1525′) 90′ }	1462	"	1610
Slate and shells	1610	"	2050
Berea Grit (gas)	2050	"	2090
Slate to bottom	2090	"	2125

Henry Gerlock Well, No. 1.

Two miles due south from Milton, on Mud river. Drilled by the Triple State Oil & Gas Company, in January, 1897. Authority, H. M. Stanbery. Well mouth 590 feet above tide.

	Feet.		Feet.
Conductor	0	to	30
Blue sand	30	"	70
Black slate	70	"	100
Red sand (10″ casing)	100	"	125
Granite (?)	125	"	145
Blue slate	145	"	195
Red slate	195	"	240
Slate and shells	240	"	265
Slate and shells (60′ and 5′)	265	"	330
Slate	330	"	340

White sand (show of oil and water)	340	"	360
Slate	360	"	400
Shells	400	"	420
White sand (8″ casing; water, 465′)	420	"	503
Black slate	503	"	508
Brown sand	508	"	540
Slate	540	"	565
White sand	565	"	625
Slate	625	"	643
Slate	643	"	708
Coal (water)	708	"	714
White slate	714	"	734
Lime and sand	734	"	759
Slate	759	"	799
Hard white sand (water)	799	"	884
Black, soft sand	884	"	896
White, hard sand	896	"	951
Black sand	951	"	971
White hard Sand (oil and water	971	to	1100
Black sand	1100	"	1108
White sand	1108	"	1153
White slate (6¼″ casing)	1153	"	1238
Shells and sand	1238	"	1270
White Sand (water 1284′)	1270	"	1284
Big Lime (show of oil 1484′)	1284	"	1500
Slate	1500	"	1560
Sand (show of oil 1595′)	1560	"	1653
Slate to bottom	1653	"	1660

Freutel well, No. 1.

Three and three-fourth miles south 30° east of Milton, on branch of Little Two Mile creek. Drilled by (Elkton) Oil Company. Authority, C. F. Cole. Well mouth 639 feet above tide.

	Feet.		Feet.
Slate, shells and sand	927	to	927
Sand (showing for 3-barrel oil)	8	"	935
Slate	40	"	975
Salt Sand with 15′ break of slate	347	"	1322
Big Lime	175	"	1497
Slate	73	"	1570
Big Injun Sand	80	"	1650
Slate and shells	439	"	2089
Berea Sand (gas)	20	"	2109
"1,000,000 cubic feet daily."			

Near Central City, below Huntington, a well was drilled by a local company for gas in 1897. The well is located about one-

fourth mile south from the C. & O. depot, on the Hisey fork of Four Pole, and starts about 340 feet below the horizon of the *Pittsburg coal*, which here caps the tops of the highest hills back from the immediate valley of the Ohio. The record was furnished by Judge T. H. Harvey, of Huntington, one of the members of the company which drilled the well, and it reads as follows:

Central City Well.

On Hisey fork of Four Pole creek, about one-fourth mile back of C. & O. depot, Central City. Authority, Judge T. H. Harvey.

	Feet.		Feet.
Conductor (clay and quicksand)	26	to	26
Shale, sand and lime (10″ inch casing 61 feet)	94	"	120
Limestone (fresh water rose 90 feet)	7	"	127
Slate, with veins of fire clay	98	"	225
Sand, fine **(Upper Mahoning, Dunkard)**	25	"	250
Slate	50	"	300
Sand, gas **(Lower Mahoning)**	30	"	330
Black slate **(Upper Freeport coal** horizon)	10	"	340
Sand, gray	60	"	400
Slate, black	10	"	410
Sand, gray	85	"	495
Slate, white and blue	25	"	520
Sand and limestone	20	"	540
Slate (cased 8″ at 547′)	20	"	560
Slate, black	175	"	735
Sand, gray	25	"	760
Slate, black, blue (coal 2 feet)	105	"	865
Sand, gas, and strong flow of salt water	30	"	895
Sand, black	10	"	905
Slate, black	30	"	935
Limestone	5	"	940
Slate, black	30	"	970
Limestone, **(Mountain,** 6¼″ casing 987′)	150	"	1120
Slate	28	"	1148
Sand, dark gray "**(Big Injun**",) some salt water	177	"	1325
Shales and slate, black	370	"	1695
Limestone or hard sand	10	"	1705
Slate, brown	25	"	1730
Sand **Berea** "salt and pepper" (oil and gas)	25	"	1755
Slate, black	10	"	1765
Sand, hard, gray	5	"	1770
Limestone	5	"	1775

Sand, gray	10	"	1785
Limestone	3	"	1788
Slate, black	2	"	1790
Limestone, bastard	4	"	1794
Shale, black	20	"	1814
Sand, (fine, black, powdery)	97	"	1911
Shales and slates, black, blue and white	574	"	2485
Limestone, bastard **(gas)**	15	"	2500
Shale	250	"	2750
Sand, gray	10	"	2760
Corniferous limestone, very hard	10	"	2770

Here the interval between the Berea Sand and the Corniferous Limestone foots up only 1005 feet, while in the Bedell well near Pittsburg the rocks were penetrated to 4010 feet below the same sand without reaching the Corniferous horizon.

WAYNE COUNTY WELL RECORDS.

Wayne county lies next west from Cabell, and like the latter borders the Ohio river, and hence its geological structure in the western portion is unfavorable for either oil or gas, as several test wells have proven. The county extends southward, however, along the Big Sandy river nearly to Warfield, where a great anticlinal axis crosses the river from Kentucky, and passes northeastward toward the Great Kanawha above Charleston.

Some large gas wells have been found near this Warfield anticlinal, and hence there are both oil and gas possibilities in the southern half of Wayne county, judged solely by the relief of the beds. The gas at Warfield comes at the same horizon as the oil near Milton, in Cabell county, and the numerous records given for that region will serve as a type of the underground succession in Wayne, as well as Boone, Lincoln, Logan and Mingo counties, in all of which gas can be found in paying quantity, and possibly oil, but it may require the drilling of many wells to develop the latter, since the pools will be of small area, and hence easily missed.

The geological succession in southern Wayne, Mingo and Lincoln counties is illustrated by well records published in Vol. I, pages 276-280, while that of northern Wayne is given by the Central City well in Cabell, and the following record of a well

just across the Big Sandy river in Kentucky, and two miles south from the Ohio river:

Brown Well.

On Catletts creek, one mile and a half south of Catlettsburg, Kentucky. Authority, Judge T. H. Harvey, Huntington, W. Va.

	Thickness. Feet	Depth. Feet.
Clay and quicksand		36
Sand	104	140
Fireclay and slate	100	240
Sand, gray	30	270
Shale	150	420
Salt Sand	150	570
Limeston, cave ("pencil") at 650′	280	850
Big Injun Sand { black sand ...100′; white sand, salt water ......15′; black sand ......35′ }	150	1000
Shale, brown, show of oil	329	1329
Berea Grit { coarse, gray sand, show of oil ......7′; hard shell ......1′; bottom shell ......3′; open, gray sand, show of oil ......10′; close, gray sand, show of oil ......16′; coarse, gray sand, show of oil ......14′ }	51	1380
Black slate	45	1425
Sand, brown	15	1440
Brown slate and sand	5	1445
Slate, black	135	1580
Shale, white	40	1620
Shells and shale	180	1800
Shells and shale	50	1850
Sand, gas (Bayard?)	5	1855
Slate, black	10	1865
Sand, black,	15	1880
Black sand and slate	3	1883
Slate, blue	4	1887
Slate, light blue	8	1895
Slate, brown	7	1902
Slate, black	69	1971
Sand, black, gas	5	1976
Sand, black, gas	4	1980
Black slate to bottom	152	2132

The Sand with gas at 1850 feet would come near the *Bayard* horizon of Marion and Monongalia, while that at 1971 feet being only 400 feet above the Corniferous Limestone (see Central City well in Cabell county) may represent any horizon from the *Speechley* Sand to the *Bradford*..

Another well drilled on the Big Sandy at the mouth of Blaine creek, five miles below Louisa, and nearly opposite Hubbardstown, in Wayne county, will illustrate the succession across the central belt of Wayne as follows:

Rigdon Well, No. 2.

On Big Sandy river, near the mouth of Blaine creek, Kentucky. Authority, F. H. Oliphant.

	Thickness. Feet.	Depth. Feet.
Drift, or surface soil	15	15
Fireclay	5	20
Sandstone, dark blue	15	35
Slate, gray	5	40
Sandstone, white	20	60
Slate, black	5	65
Sandstone, dark	30	95
Slate, black	50	145
Coal	4	149
Fireclay	7	156
Sandstone, white	45	201
Sandstone, dark gray	10	211
Sandstone, white	10	221
Slate, black	15	236
Sandstone, dark	25	261
Slate, black	10	271
Coal	3	274
Slate	27	301
Sandstone, gray	6	307
Slate, black	24	331
Sandstone, gray	25	520
Coal	7	362
Fireclay	3	365
Sandstone, gray	70	435
Slate, gray	60	495
Sandstone, gray	25	355
Slate, black	60	580
Sandstone, white	25	605
Slate, black	5	610
Sandstone, white	20	630
Sandstone, dark gray	25	655

Slate, gray	15	670
Sandstone, black	20	690
Slate, gray	20	710
Sandstone, dark gray	40	750
Sandstone, white, salt water	100	850
Sandstone, dark blue	10	860
Slate, black	10	870
Sandstone, white, base Pottsville	90	960
Slate, black	25	985
Sandstone and shells	10	995
Sandstone, hard, blue	30	1025
Big Lime	140	1165
Big Injun Sand { sand, white, salt water 5′; Sand, white and shells 20′; Sand, greenish gray....75′ }	100	1265
Slate, green	65	1330
Slate, bluish gray	375	1705
Slate, black	27	1732
Gas Sand, fair flow of gas (Berea Grit)	60	1792
Shale, black to bottom	53	1845

This well begins 50 to 100 feet below the base of the Conemaugh formation.

In northern *Boone county*, near Racine, and ten miles west from the Great Kanawha river, a gas pool has been developed at the same horizon in the Lower Carboniferous or Mississippian formation that holds the oil in Cabell, as may be observed from the following record:

Workman Well, No. 1.

Racine district. Authority, South Penn Oil Company.

	Feet.		Feet.
Gravel			35
Sand	50	to	80
Slate	80	"	195
Sand	195	"	305
Coal (8¼ Casing)	305	"	309
Sand	309	"	370
Slate	370	"	385
Sand	385	"	405
Slate	405	"	415
Sand	415	"	435
Slate	435	"	445
Sand	445	"	585
Slate	585	"	630
Sand	630	"	790
Lime, shell etc	790	"	890

Sand and lime	890	"	970
Red rock	970	"	990
White slate	990	"	1006
Hard Sand (Maxton?)	1006	"	1125
Big Lime (cased 6¼")	1125	"	1160
(Big) Lime and (Big Injun Sand)	1160	"	1390
Red rock	1390	"	1401
Total depth			1401

"Little Sand 1356'; show oil; filled up 20 feet."

The *red rock* at 970 feet is an important geological marker, since it sets off the Pottsville beds above from the Mississippian below.

KANAWHA COUNTY has the distinction of being the first locality in the United States to inaugurate the use of Natural Gas for manufacturing purposes (see Historical sketch in this Volume, Chap. I). The gas pool along the crest of the Brownstown anticlinal, nine miles south from Charleston is practically exhausted, however, since gas from the same horizon as that indicated in the Racine pool of Boone county, viz: the Big Injun Sand, has been flowing to the surface for 65 years or more through wells drilled for salt water. The underground rock succession of this region around Brownstown is given in Vol. I, page 272.

A test well was drilled for oil and gas on the Kanawha river bottom, about five miles below Charleston and one mile below Lock No. 4. It begins near the middle of the *Conemaugh formation,* and the record runs as follows, acoerding to J. W. Penhale of Charleston:

	Thickness. Feet.	Depth. Feet.
Conductor	45	45
Sandstone	405	450
Coal	5	455
Santstone	35	490
Slate and shale	220	710
Sandstone	10	720
Slate and shale	40	760
Sandstone	50	810
Shale	10	820
Lime	35	855
Sandstone	45	900
Coal	3	903

Sandstone		7	910
Shale		35	945
Sandstone (Pottsville)		480	1425
Big Lime and Big Injun	Lime 213′; Slate and shale 25′; Sandstone 47′	288	1710
Shale		425	2135
Shells and shale		115	2250
Shale		145	2395
Sandstone		5	2400
Shale to bottom		208	2608

The succession at Charleston is given by the following record, for which Hon. W. S. Edwards of that city stands sponsor:

Well at Charleston, Kanawha County.

		Thickness. Feet.	Depth. Feet.
Conductor		28	28
Unknown		12	40
Shale		34	74
Coal			
Sandstone		76	150
Shale		42	192
Coal			
Shale and sandstone		68	260
Limestone		20	280
Sandstone		60	340
Shale		60	400
Sandstone		70	470
Coal			
Unknown		20	490
Shale		20	510
Sandstone		50	560
Shale		30	590
Sandstone		355	945
Unknown		55	1000
Sandstone		170	1170
Shale		10	1180
Big Lime and Big Injun	Limestone 10′; Sandstone 60′; Limestone 200′; Unknown 25′; Sandstone, pebbly 40′	335	1515
Sandstone, red		85	1600
Sandstone, shelly and slaty		12	1612
Sandstone		80	1692
Shale to bottom		148	1840

FAYETTE COUNTY lies east from Kanawha, and therefore within the zone of the greatly thickened Kanawha and New

River formations, so that neither oil nor gas has been found in the two or three borings made within its borders. The chances that they will be found are very few, since the southeastward rise of the strata is even *more than* offset by the thickening of the measures, since the record of a well drilled at Powellton found the top of the Big Lime at 1620 feet, 650 feet below tide, while in the Edwards well at Charleston, 25 miles northwest the top of the Big Lime is only 580 feet below tide, or practically level between the two points, while the *Kanawha Black Flint* which is only 550 feet above tide at Charleston rises to 1840 feet above at Powellton, thus showing that the dip of the surface beds in the Fayette county region is no index to the structure of the deeply buried and unconformable (to the Coal Measures) *oil sand* deposits. Hence, from data of this kind, we learn that the Big Lime, and underlying Big Injun Sand together with whatever of the Venango Oil Sand Group may be represented, are practically horizontal over a wide belt of country, extending from the latitude of Charleston southeastward to the limit of the New River-Pocahontas coal field or Great Flat Top Mountain, and therefore could not be expected to hold pools of either oil or gas in paying quantity, the necessary *relief structure* being *absent* from these oil-bearing beds.

Powellton Well.

"Top of well 970 feet below Black Flint and 300 feet below Upper Clarion Coal. Estimated to be 83 feet above top of No. XII measures." Authority, D. T. Evans.

	Feet.		Feet.
Shale	0	to	48
Gray sandstone	48	"	66
Shale	66	"	67
Gray sandstone	67	"	81
Slate	81	"	83
White sand	83	"	278
Coal	278	"	280
Sandstone	280	"	289
Shale	289	"	294
White hard sandstone	294	"	305
Shale	305	"	345
Shale	345	"	610
Black shale, limy	610	"	628

Gray lime	628	"	632
Buff colored and sandy lime	632	"	635
Sandstone	635	"	638
White sandy lime	638	"	681
Black slate	681	"	684
Limestone	684	"	707
Sandstone, white and pebbly	707	"	800
Black slate and shale	800	"	850
Shale and sandy lime	850	"	856
Shale	856	"	862
Lime and slate	862	"	885
Pebbly sand, with gas	885	"	895
Clayey shale	895	"	904
Lime	904	"	917
Clayey shale	917	"	1020
Brown shale	1020	"	1035
Lime	1035	"	1068
Red rock and lime shell	1068	"	1260
Lime shell and slate	1260	"	1275
Red rock	1275	"	1325
Lime, with shale pebbles	1325	"	1345
Lime	1345	"	1360
Red rock	1360	"	1408
Lime shell	1408	"	1415
Red rock, limy	1415	"	1475
Slate	1475	"	1496
Sandstone	1496	"	1530
Sandstone, hard black and white	1530	"	1552
Slate and lime shells	1552	"	1603
White limestone	1603	"	1606
Dark limestone	1606	"	1615
Slate, pencil cave	1615	"	1620
Lime, solid (top of Big Lime)	1620	"	1680
Slate	1680	"	1883
Gray lime	1883	"	1925
Mottled lime	1925	"	1938
Black shale, limy	1938	"	1942
Gray lime	1942	"	1956
Red sandy shale with various colored pebbles, (top of Big Injun)	1956	"	1965
Fine, hard, dark sand	1965	"	1970
Sandy shale gradually growing into very fine hard sand	1970	"	2050
Gray rotten water sand, coarse open grained and pebbly	2050	"	2067
Shale gradually growing to hard impure limestone	2067	"	2140
Slate and shale	2140	"	2895

Two or three test wells have been bored in *Summers County,* which lies still south of Fayette, and extends nearly to the Virginia line, but only traces of oil and gas were found. One of these wells was bored at Crumps Bottom, near the southern end of Summers, and its record is as follows:

Crumps Bottom Well.

Crumps Bottom, Summers county. Authority, Charles H. Mellon, Philadelphia, Pa.

		Thickness. Feet.	Depth. Feet.
Unrecorded		95	95
Shale, gray, limy		15	110
Shale, gray limy		15	125
Sandstone, gray, pebbly		75	200
Shale, red		100	300
Sand, dark, gray		60	360
Dark sandy beds		290	650
Bluish-gray, limy beds		50	700
Sandstone, greenish-gray		190	890
Shale, red, sandy		30	920
Limestone, gray		18	938
Limestone, dark		7	945
Limestone, dark, slaty		195	1140
Limestone, dark gray, slaty		15	1155
Limestone, dark gray		170	1325
Shale, red		65	1390
Big Lime	Limestone, dark gray..435′ Limestone, light gray.. 65′ Limestone, dark gray.. 95′ Limestone, light gray.. 5′ Limestone, steel gray..345′	945	2335
"Keener"	Shale, red sandy 60′ Shale, gray sandy 15′ Sandy beds, purple 52′	127	2462
Big Injun	Sandstone, grayish-white .... 8′ Shell, with gas (little).22′ Sandstone, dark-gray ..18′ Sandstone, gray ......15′ Sandstone, hard, brown..10′ Sandstone, hard dark brown ....15′ Sandstone, hard dark shelly .... 5′ Shale, dark, sandy ....15′ Sand, shells, quartz and pebbles.. ....20′ Gray sandy beds.......10′ Gray sandy beds......25′	163	2625

Shales, sandy, dark gray	60	2685
Sandstone, dark, shaly, with coal streaks	9	2694
Sandy beds, dark shaly	11	2705
Shale, gray sandy	15	2720
Sandstone, gray, shaly	20	2740
Sandstone, gray, shaly	15	2755
Shale dark, gray sandy	45	2800
Green sandy beds	25	2825
Sandy beds, dark gray	20	2845
Sandstone, gray, hard	15	2860
Sandstone, dark gray	40	2900
Sandstone, grayish-white	25	2925
Sandstone, grayish	20	2945
Sandstone, white, mixed with dark slate	10	2955
Sandstone, grayish-white, mixed with dark slate	20	2975
Slate, dark, with sandstone	25	3000

The elevation of the surface where the Crumps Bottom well begins is about 1500 feet above tide, so that the top of the Big Lime is here only (1500′—1390′) 110 feet above that datum, while it is 1000 to 1200 feet up to the base of the Pottsville in the summits of the mountains, and then 2500 feet higher to the plane of the Black Flint, so that if the latter stratum were present at Crumps Bottom, the mountain in which it could be found would have a height of (1500+1100+2500)=5100 feet above sea level, or to put the case in other words, while the Kanawha Black Flint bed has risen from 550 feet above Tide at Charleston to 5100 feet above tide at Crumps Bottom, the "Big Lime," or main mass of the Greenbrier Limestone has only risen from 580 feet below tide to 110 feet above, or say 700 feet in all in a distance of 70 odd miles, and the most of the elevation has probably taken place within the last ten miles since Crumps Bottom is close to the great folds of the Alleghany Mountain uplift.

Even *Greenbrier County* has been perforated for oil. The Big Injun Sand crops to the surface along the Greenbrier river at Ronceverte where its top is 70 to 100 feet above the water, and above it comes the great mass of the Greenbrier Limestone (Big Lime) many hundreds of feet in thickness. Some dark heavy oil, probably escaped from the Big Injun Sand, was collected from the dam of one of the lumber companies a few years

ago, and this led to the drilling of a test well at Ronceverte, but of course nothing of value was discovered.

The Oil and Gas Horizons of West Virginia.

From these numerous well records given over a large region of the State as well as the running commentary thereon, it will be perceived that there are several well defined oil and gas horizons between the *Permian* rocks at the top of the *Carboniferous,* and the *Corniferous Limestone* at the base of the *Devonian beds.* These may be grouped together and classified as follows, in descending order, together with the geological series in which they occur:

No. XV, Upper Coal Measures, Monongahela Formation.	**Carroll Sand.**
No. XIV, Barren Measures, Conemaugh Formation.	**Moundsville (Morgantown). First Cow Run Sand, Upper and Lower Dunkard Sands.**
No. XIII, Lower Coal Measures Allegheny Formation.	**Second Cow Run Sand, "Gas" Sand of Marion and Monongalia Counties.**
No. XII Pottsville Conglomerate beds, New River and Pocahontas Coal Series.	**"Gas" Sand of Cairo, "Salt Sand", Cairo?**
No. XI, Mauch Chunk Red Shale	**Maxton, Cairo?**
No. XI, Mountain or Greenbrier Limestone.	**No oil or gas horizons except as part of the "Big Injun" below unless the Beckett Sand of Milton field should belong here.**
No. X, Pocono Sandstone.	**"Keener" Sand, "Big Injun" Sand, "Squaw" Sand.**
No. IX, Catskill Red Reds, Upper Devonian Series, Venango Oil Sand Group.	**Gantz Sand (Berea Grit), Fifty-Foot Sand, Thirty-Foot Sand, "Stray" Sand, Campbell's Run "Gordon" Sand, Whetstone Run "Gordon" Sand, Flat Run "Gordon" or Fourth Sand, McDonald or Fifth Sand, Bayard or Sixth Sand.**

No. VIII, Chemung, Hamilton and Corniferous Beds, Middle Devonian.	**No well defined oil or gas horizons yet discovered in these rocks in West Virginia. Warren, Tiona, Speechley, Balltown, Sheffield and Bradford Sands of Pennsylvania supposed to belong in upper portion.**

The *Bayard (Sixth) Sand* is then the lowest known oil and gas bearing rock yet discovered in West Virginia. Whether any of the rocks below it will ever produce oil or gas in profitable quantity within the State is a problem for future operators to determine.

In the adjoining State (Ohio), about 300 miles distant from the West Virginia border, the *Trenton Limestone* of the *Lower Silurian,* has proven very rich in both oil and gas, while in the Sugar Grove region of Ohio, only 60 miles north from the West Virginia line on the Ohio river, the *Medina* or *Clinton beds* of the *Upper Silurian* have yielded a wonderful supply of high pressure natural gas to the cities of Columbus, Zanesville, Logan, Lancaster, Nellsonville, Toledo, etc. In New York, Dr. Orton reports the finding of very high pressure gas wells in the *Potsdam Sandstone,* at the very base of the *Palaeozoic column,* and only a few feet above the primitive granite.

It was formerly supposed that no oil or gas in commercial quantity would be found in rocks below the *Catskill series* of the *Devonian*, but as that belief has now been completely overthrown by the results of the drill, and as both theory (anticlinal) and facts of the present, unite in proving that the only conditions necessary for the accumulation of large quantities of gas or oil, are porous, stratified rocks, thrown into waves of considerable but not too violent relief, with a cover sufficiently impermeable to prevent escape, there remains no sound reason why there may not be other oil and gas reservoirs under the surface of West Virginia, far below the *Sixth*, or *Bayard Sand.*

It is true that except in the south-western part of the State, say from the Little Kanawha river, westward, it would probably be impossible at the present stage of the deep drilling art, to

reach any of these horizons even in the *Upper Silurian, (Medina)* but this may be possible, and even profitable some time in the future. To reach the Medina horizon, anywhere in the Monongalia, Marion, Wetzel, Tyler or Doddridge county oil fields, would require a boring probably not less than a mile and a half in depth, and the *Trenton horizon* would then be possibly a half mile farther below. But in the region of Huntington, the *Corniferous Limestone* which lies 600 to 800 feet above the Medina, was struck only at 2760 feet, and hence in that portion of the State where the *Catskill, Chemung* and *Hamilton beds* have *thinned away* so greatly, it will be quite easy to bore to the *Medina gas horizon,* and even possible to reach the *Trenton,* though owing to the absence of the proper *relief* of *structural features,* it is doubtful if either would be found gas or oil bearing in that region.

As stated on a preceding page, the *mountain regions* of the State have not been properly tested for the presence of gas or oil, since from the great size of the anticlinal arches in those regions, and the necessary fracturing, and fissuring of the rocks resulting from these steeply folded strata, any borings must necessarily go to a great depth (5,000 to 10,000 feet) in order to give a fair test under such conditions.

Upon the theory of the origin of natural gas and petroleum from buried organisms (both animals and plants,) and there are but few geologists who advocate any other, it would appear entirely reasonable to believe that enough organic matter has been entombed in any of the earth's stratified, or sedimentary beds, to furnish large supplies of the hydro-carbon compounds, in the form of either oil or gas, or both, provided the small quantities of each in any of such strata, can find a *porous reservoir* in which to collect, and a *geological structure* (the rocks disturbed by *anticlinal waves,* or rapid and irregular dips) favorable to the segregation and preservation of the same. Of course if the rocks be highly contorted, fractured, faulted, or too greatly disturbed, all of these liquid or volatile hydro-carbons within reach of ordinary drilling operations will have escaped from the strata and it will prove useless to explore for them, even in sedimentary beds,

and it goes without saying that no stores of either oil or gas need be looked for in crystalline or metamorphic rocks of any description, such as granites, syenites, schists, etc.

Character and Quality of West Virginia Petroleum.

All of the oil produced in the State belongs to the highest grade and quality of Pennsylvania petroleum of the "white sand" type. It has a paraffine base instead of asphalt as in Russian and most foreign oils, as well as in that from California, Wyoming, Colorado, Texas, and all regions yielding petroleum from rocks of recent geological age, since the paraffine oils appear to be confined almost exclusively to rocks of the *Palaeozoic* or *Mesozoic Era.*

The color of the West Virginia petroleum ranges from almost black through all shades of green and amber up to a nearly transparent fluid with only a tinge of yellow, while the gravity varies from 28° B., a good quality of lubricating oil, occurring in the "Salt Sand" of the Volcano region, Ritchie county, at a shallow depth, to 63½° B., the lightest gravity petroleum known in the world, found in the *First Cow Run Sand*, near Moundsville, Marshall county.

Mr. H. L. Scrafford, General Manager of the Eureka Pipe Lines in West Virginia, has kindly furnished the Survey a statement of the gravity, color, etc., of the oils from the different sands in West Virginia, and the adjoining region of south-eastern Ohio, as handled by the pump stations in the several regions. These oils would show a little higher gravity if the samples had been taken direct from the wells, but those given are the gravities of the several oils after they had been transported to the different local pumping stations, and hence represent them on a commercial basis. This table which often includes several samples in the same region is as follows:

Location of Pump Station.	County.	Sand.	Gravity °'s B.	Color.
Mt. Morris	Greene, Pa.	Big Injun	46	Amber
" "	" "	Dunkard	42	"
" "	" "	Elizabeth, Sixth	41	"
Dolls Run	Monongalia	Big Injun	46	"
Jakes Run	"	" "	46	"
Basnett, Fairview,	Marion	Gordon	$43\frac{1}{2}$	"
" "	"	Big Injun	$45\frac{3}{4}$	"
Downs, Mann'gton	"	Gordon	$42\frac{3}{4}$ to $43\frac{1}{2}$	"
" "	"	Big Injun	$46\frac{1}{2}$	"
Tetrich	"	Gordon	$42\frac{1}{2}$	"
Joetown	"	"	$42\frac{3}{4}$	"
Masters, Board Tree	Greene, Pa.	"	$42\frac{1}{2}$	"
Glendale	Marshall	First Cow Run	$63\frac{1}{2}$	"
Arches	Wetzel	Dunkard	$52\frac{1}{2}$	"
"	"	Big Injun	$45\frac{3}{4}$	"
"	"	" "	$46\frac{1}{2}$	"
"	"	" "	$48\frac{1}{4}$	"
"	"	Gordon	$39\frac{1}{4}$	"
"	"	"	$42\frac{1}{4}$	"
Richwood	"	"	$43\frac{3}{4}$	"
Pine Fork	"	"	$44\frac{1}{4}$	"
Braden, Indian Cr.	Tyler	Big Injun	$47\frac{1}{4}$	"
" "	"	Gordon	$44\frac{1}{4}$	"
Big Flint	Doddridge	Dunkard	$48\frac{1}{4}$	Black
" "	"	Maxton	45	Amber
" "	"	Big Injun	$42\frac{1}{4}$	Black
" "	"	" "	$43\frac{3}{4}$	"
" "	"	" "	$45\frac{1}{2}$	Amber
" "	"	" "	$46\frac{1}{2}$	"
" "	"	" "	$47\frac{1}{2}$	"
" "	"	Gordon	42	"
" "	"	"	$43\frac{3}{4}$	"
" "	"	"	$48\frac{3}{4}$	"
" "	Harrison	Fifth, McDonald	44	"
Ankrom, Indian Cr.	Tyler	Maxton	$45\frac{1}{2}$	"
" " "	"	Big Injun	48	"
" " "	"	"	$46\frac{1}{2}$	Black
Martin, Elk Fork	"	Keener	$49\frac{3}{4}$	Amber
Sancho (Bradens)	"	Maxton	43	Black
" "	"	Big Injun	50	Amber
Wick	"	Cow Run	47	Green
"	"	Maxton	47	Black
"	"	Keener	45	Amber
"	"	Big Injun	52	"
Hebron	"	Cow Run	46	Green
"	"	Big Injun	$46\frac{3}{4}$	Amber
Stewart, Mid'e IslCr	"	Cow Run	54	"
" " " "	"	Maxton	44	Black
" " " "	"	Keener	$53\frac{3}{4}$	Amber
" " " "	"	Big Injun	$44\frac{1}{2}$	"
" " " "	"	" "	$46\frac{3}{4}$	Green
" " " "	"	" "	54	Black

Location of Pump Station.	County.	Sand.	Gravity, °'s B.	Color.
Thistle, Sistersville	Tyler	Keener	48	Amber
" "	"	"	47	"
" "	Monroe, O.	"	47¾	"
" "	"	Salt Sand	44	"
" "	"	Big Injun	47½	"
" "	"	" "	50	"
" "	"	" "	50½	"
" "	"	Maxton	47	Black
" "	"	Berea	46½	Amber
Trail Run	Washington, O.	Keener	44½	"
" "	"	"	46	"
" "	"	"	46¾	"
" "	"	Big Injun	47	"
" "	"	" "	48	"
" "	"	" "	49	"
Cairo	Ritchie	Salt Sand	45½	"
"	"	Big Injun	50	"
Pennsboro	"	Boulder	41	"
Burning Springs	Wirt	Cow Run	39	Green
" "	"	Big Injun	51	"
Volcano	Wood	Salt Sand	34½	"
"	"	Berea	50½	"
Mounts, Stillw'l Cr.	"	"	41	"
Boreman, Worthington Creek	"	"	39½	"
Big Run	"	Cow Run	43	"
Bull Cr. Waverly	"	" "	46	"
" " "	"	Big Injun	40	"
Eureka	Pleasants	Cow Run	46	"
"	"	Berea	51	"
"	Washington, O.	Shallow	42	"
"	"	First Cow Run	49	"
"	"	" " "	50½	Lig't Green
"	"	Second " "	43½	Dark "
"	"	Salt Sand	42	" "
"	"	Big Injun	42	Green
"	"	" "	53¼	Amber
"	"	Berea	41	Green
"	"	"	47½	Amber
Corning	Athens, O.	"	38	Black
New Castle	Monroe, O.	"	43	"
Barnesville	Belmont, O.	"	44	"

Mr. Ray V. Hennen, Engineer and Chief Clerk of the Survey, has recently visited several of the producing regions of the State and made a few tests of the gravity of the oils as they come fresh from the wells as well as that of some bottled samples. His results are embodied in the following table:

Location of Sample Near	County.	Sand.	Gravity °'s B.	Farm and Well No.	Remarks.
Milton Field	Cabell	Keener	40.6	C. E. Burns No. 2	Fresh oil
" "	"	"	40.6	C. Beckett No. 1	" "
" "	"	"	40.9	J. Harshbarger No. 1	" "
" "	"	"	33.1	E. W. Beekett No. 1	1st in fi'd stan-ing 1 month
" "	"	"	34.9	" " "	Bottled sample
" "	"	Cow Run	42.4	" " "	" "
" "	"	Keener	40.7	" " 2	Fresh oil
" "	"	Cow Run	46.2	" " 3	Saved by drill's
" "	"	Keener	41.1	T. J. Berkley 1	Fresh oil
Yellow Creek	Calhoun	Gantz (?)	42.0	J. Metz 2 and 4	Old wells
" "	"	"	41.2	J. Metz 1 and 3	" "
" "	"	"	43.0	J. Metz 4	" "
" "	"	"	44.3	J. Metz 6, 7 and 8	" "
" "	"	"	48.3	S. Selman No. 1	New, largest in fi'd when str'k
" "	"	"	45.5	Oaf Taylor No. 2	
Rowels Run	"	"	44.1	R. Curry No. 1	1st in field
" "	"	"	44.6	E. A. Fore No. 2	20 bbl. well
Chester	Hancock	Berea	49.3	S. A Richmond 2	Fresh oil
"	"	"	48.0	" " 1	" "
"	"	"	47.7	" " 4 and 5	" "
"	Beaver, Pa.	"	46.0	T. M. Nickle No. 1	W. Va.-Pa. line
Moundsville	Marshall	Dunkard	47.5	Higgins 1, 2 and 3	In tank s'etime
Amos P. O.	Marion	Fifth	43.8	S. J. Harvey No. 4	
" "	"	Bayard	42.1	Wilson H'rs No, 9	Deepest oil w'll in wo'd 3631 ft)
Cairo	Ritchie	Keener	45.0	J, Moats No. 5	Fresh oil
"	"	"	45.9	S. Moats No. 4	" "
"	"	Salt	43.1	R. Moats No 2	" "
"	"	Big Injun	45.8	A. M. Douglas No. 1	1st in f'd (14 yr)
"	"	"	43.6	D. M. Sleeth No. 1	Fresh oil
"	"	Carroll	46.0	A. Y. Pew No. 2	Bottled sample
"	"	"	40.9	J. C. Lee No. 10	" "
Smithville	"	Big Injun	41.1	Wm. Barker No. 2	" "
Burton	Wetzel	Maxton	43.5	W. G Snodgrass No. 1	90 bbl, well
"	"	"	44.0	J. Santee No. 2	Bottled sample
Burning Spr'gs	Wirt	2nd Cow Run	39.1	Roberts Brothers	
"	"	Salt	38.0	" "	
"	"	"	37.0	A. P. Clark 1-6	
"	"	2nd Cow Run	42.8	Roberts Brothers	
"	"	500 ft.	33.3	" "	
"	"	Keener	41.8	" "	

CHAPTER V.

THE COMPOSITION OF NATURAL GAS.

In the annual report of the Second Geological Survey of Pennsylvania, Part I, Oil and Gas, for 1886, pages 787-827, there was published a very important paper on "The Chemical Composition of Natural Gas" by Professor Francis C. Phillips of the Western University of Pennsylvania. Since this elaborate paper of Professor Phillips is not now generally accessible, and owing to the importance of natural gas as a source of heat in West Virginia, this valuable paper of Professor Phillips is herewith re-published in full, together with the explanatory note of the late Mr. C. A. Ashburner, as follows:

*THE CHEMICAL COMPOSITION OF NATURAL GAS.**

By Francis C. Phillips,

Professor of Chemistry, Western University, Allegheny, Pa.

Introduction.

Natural gas, as obtained from several of the most productive fields in Pennsylvania, according to the analytical data presented

*Prof. Phillips has spent considerable time in the study and practical investigations of gaseous fuels, and at my request he was commissioned in the early part of the year to make analyses of the natural gas from eight of the most prominent pools in the State, and one analysis of the Fredonia gas in New York

The first systematic investigation as to the composition of natural gas in the State, was made by the Geological Survey in 1875, the results of which were published in a Report on the Use of Natural Gas in Iron Manufacture, in 1876. Since 1883, when the use of natural gas for fuel became more general, numerous analyses of the different gases have been made by a number of chemists. The wide differences in the composition of the gases as shown by these analyses were so great that Prof. Phillips exercised more than special care in the collection of his samples, and in the method of determining the individual constituents of the gases. All analyses were made in duplicate.

C. A. ASHBURNER,
Geologist in Charge.

in this report, consists chiefly of the hydrocarbons of the paraffin series, together with nitrogen, a small proportion of carbon dioxide and traces of oxygen. Free hydrogen was found in minute quantity in Speechley gas. It is possible that by employing many thousand cubic feet of gas, traces of other constituents might be discovered. Inasmuch as the composition of natural gas possesses an interest for those who are not familiar with the strictly chemical aspect of the question, a few preliminary statements as to the more characteristic properties of its chief constituents will no doubt prove of value in this connection.

Hydrogen is obtained as a gas by the action of dilute sulphuric acid upon zinc. It is also produced during the putrefaction of vegetable matters buried under stagnant water. Its specific gravity is 0.069234 as compared with air. One cubic meter weighs 0.089523 kilogram. One cubic foot weighs 39.12 grains. Hydrogen is odorless and tasteless. It takes fire at a bright red heat, and more readily than other constituents of fuel gases.

Hydrogen in burning generates 34180 heat units per unit weight burned. The product of its combustion is water.

In fuel gases hydrogen may occur in two very different forms.

In its *free* and *uncombined* state, it is often reported in the analyses of natural gas, and constitutes generally from 30 per cent. to 40 per cent. by volume of ordinary coal gas, being a product of the destructive distillation of coal at very high temperatures. The presence of a large proportion of *free* hydrogen in a gas fuel causes it to burn with a relatively small admixture of air, since one volume of hydrogen requires only one-half volume of oxygen, or two and one-half volumes of air for complete combustion. The hydrogen flame is non-luminous.

In *combination with carbon*, in the form of hydro-carbons, hydrogen constitutes about one-fourth by weight of the combustible portion of the natural gas now being used as fuel in Pennsylvania.

These hydro-carbons, which represent approximately nine-

tenths by volume of natural gas, are divided into two classes: Paraffins and Olefines. Of the paraffins, the best known and most abundant is methane ($C\,H_4$) consisting of 25.03 per cent. hydrogen, and 74.97 per cent. carbon by weight.

Methane is, like hydrogen, a product of the destructive distillation of coal, and consequently constitutes a large proportion of ordinary coal gas. It is also produced with hydrogen when plants decay at the bottom of rivers and swamps, and hence its older name of marsh gas. Methane, when pure is odorless, and not poisonous. Its specific gravity is 0.55297. One cubic meter weighs 0.7148 kilogram. One cubic foot weighs 312.36 grains. It is converted into a liquid under a pressure of about 2700 lbs. per square inch at 12° F., or at 263° below zero F., under atmospheric pressure. Methane requires twice its volume of oxygen or ten volumes of air for its complete combustion, and the products are carbon dioxide and water vapor.

The Hukill well, Lyon's run, south of Murrysville, as already stated, yields this gas in a nearly pure condition. Methane contains *in one cubic foot, two cubic feet of hydrogen,* and hence in the union of the carbon and hydrogen, a considerable condensation occurs. Methane is the typical and best known member of a large group of hydro carbons, which exhibit a remarkable resemblance in chemical relationships. The following list includes several of the most important:

Methane,	CH_4
Ethane,	C_2H_6
Propane,	C_3H_8
Butane,	C_4H_{10}
Pentane,	C_5H_{12}
Hexane,	C_6H_{14}
Heptane,	C_7H_{16}
Octane.	C_8H_{18}
	$C^n\,H_2{}^n{+}_2$

The first four hydro-carbons are gases, but are more and more easily condensable to the liquid form in proportion as the amount of carbon is greater. The higher paraffins are solid. Common "paraffin wax" contains several of the highest members. While Methane (CH_4) constitutes from 50 per cent. to 90 per cent. or more of Pennsylvania natural gas, Ethane, (C_2H_6) the next

member of the series occurs in smaller quantity. Concerning the higher members, Propane, (C_3H_8), and Butane, (C_4H_{10}), very little is as yet known, but there is reason to think that they are of common occurrence. Pentane, (C_5H_{12}), is found in the lightest distillates from petroleum, and the higher members are found in abundance in crude oil. It may be said concerning the gaseous hydro-carbons of the series that they possess higher specific gravity, fuel value and illuminating power, and also stronger odor in proportion as the percentage weight of carbon is greater.

The illuminating power of pure methane, artificially prepared, has been determined as 5.15 to 5.20 standard candles per 5 cubic feet burned per hour. (Wright, Chemical News, 1885, p. 102.)

The second class of hydro-carbons found in gas and petroleum includes the Olefines. Of these the typical member is Ethylene or Olefiant gas, (C_2H_4) Ethylene is one of the products of the action of heat upon coal and various vegetable substances. It is a gas having a specific gravity of 0.96744. Condensable to a liquid at a temperature of 166° below zero F. According to Frankland its illuminating power is equal to 68 standard candles, and hence the name "illuminating hydro-carbons" often given to the group. One cubic foot in burning requires 3 cubic feet of oxygen, or 15 cubic feet of air. On account of their limited occurrence, olefines in many cases have no influence upon the fuel value of natural gas. They appear to be more abundant among the less volatile hydro-carbons of petroleum.

Whether hydrogen occurs in the *free state* in a gas fuel, or as a hydro-carbon, the product of combustion will invariably be water vapor, mixed in the latter case with carbon dioxide.

Carbon Dioxide, CO_2. Well known as a universal product of decay, and as a gaseous furnace product, Carbon Dioxide or Carbonic Acid is everywhere present, in the air, in water and in the soil and rocks.

A suffocating gas, having a specific gravity of 1.5241. 1 cubic meter weighs 1.9650 kilogram.

Condensable to a liquid under 780 lbs. pressure at 60° F.

Being incombustible its presence in gas (varying from a trace to 4 or 5 per cent.) tends to reduce to a corresponding degree the fuel value. Its presence may readily be shown by causing the gas to stream slowly through lime water, in which a milky deposit of carbonate of lime soon begins to form.

Nitrogen.—As a diluent of greater influence upon fuel value, we must regard nitrogen, on account of its occurrence in larger quantity. Constituting 4-5 of atmospheric air, it is well known for its chemically indifferent character. In gas fuels it reduces the heating power in proportion to its quantity.

Gas from the Hukill well, Lyon's run, contained 2.02 per cent. while gas from Houston (near Canonsburg) contained 15.30 per cent. of nitrogen. Should the natural gas supply ever become seriously diminished, it is probable that a time will come when the actual calorific power will be an important factor in determining the market value. In that event the proportion of carbon dioxide and nitrogen, as well as the character of the hydro-carbons, will possess great interest for the gas companies and the consumers.

Oxygen being well known as the constituent of atmospheric air which is the active cause in all cases of combustion slow or rapid, its presence in natural gas would seem improbable. Contact of Oxygen with the oxidizable elements of gas under high pressure would appear likely to cause its absorption and the formation of a corresponding amount of carbon dioxide or water. Nevertheless minute traces are constantly found and are indicated with great positiveness in gas as it flows directly from the wells and under high pressure. It has been experimentally shown that oxygen and nitrogen may be dissolved and held in mechanical solution by petroleum, and that oxygen is even more soluble in petroleum than in water. (St. Guiswosz, Reports of the Berlin Chemical Society, 1887 p. 188.)

For its liquifaction methane requires, as already stated, a pressure of at least 2,700 lbs. at common temperatures. Ethane is liquified under a pressure of 690 lbs. Carbon dioxide requires a pressure of 780 lbs.

Far greater pressures are needed for the liquifaction of oxygen, nitrogen and hydrogen.

It is a fact of much interest in this connection that in the case of methane, the principal constituent of natural gas, the pressure under which liquifaction takes place is about four times that found in the most productive gas wells.

If in the reservoir tapped by the well a pressure exists four times greater than that at the well mouth, it is probable that the expansion there resulting would cause a marked lowering of the temperature in the well.

It is commonly found however that the main leading from the well mouth does not possess a temperature much lower than the air. From this it seems probable that methane cannot exist in a liquified state in the rocks.

The carbon dioxide and ethane, on the other hand, may occur constantly in liquid form in the rocks to which many of the wells penetrate.

Collection of Samples.

Glass vessels having a capacity of 250 to 400 cubic centimeters were carefully dried by a current of warm air, and in order to obtain the gas as nearly as possible free from moisture the following method was employed:

Glacial phosphoric acid, partially cooled from fusion, was drawn out into fine threads. A considerable number of such threads, in short pieces, could be pushed through the glass stopcocks, by which the vessels were closed, and left in the vessels which were then ready for the reception of gas samples. It is of importance to state that these vessels had been long in use for the same purpose and had been proved to be air-tight by thorough and repeated tests.

In collecting the samples several of these glass cylinders were connected in a series with the well or main by short rubber hose, and gas allowed to flow for twenty minutes through them all.

The stopcocks were then closed in such a manner as to leave a slight excess of gas pressure in each vessel.

The stopcocks (which had previously been well greased with a mixture of tallow and wax) were then wound over and completely covered by fine cord, so that each resembled a ball of cord. The capillary ends of the cylinders were then closed by short pieces of thick rubber hose plugged with glass rods.

By this mode of wrapping all movement of the stopcocks during transportation on railroads is prevented.

The gas thus left in contact with the glacial phosphoric was gradually dried and ready for analysis on reaching the laboratory.

The common method of taking a gas sample in a glass cylinder having finely drawn out ends, which are to be sealed by a flame when the vessel is filled, is not applicable in the case of natural gas. The constant escape of gas about a gas well renders the use of a flame absolutely impossible on account of the danger of accident. Vessels closed by glass stopcocks are now supplied by dealers, capable of holding a gas sample for many weeks without risk of leaking.

Method of Analysis.

The determination of carbon and hydrogen existing in combustible form in the gas was conducted by combustion over oxide of copper in a porcelain tube, which was kept at a bright red heat, and the resulting carbon dioxide and water collected separately and weighed.

One of the glass cylinders, filled with gas at the well, was placed in a vertical position and the temperature observed at intervals.

When it was found that the temperature had remained constant for two hours, the lower stopcock was opened for a moment to allow the excess of gas to escape and secure equilibrium between the pressure of the gas inside and that of the atmosphere. At the same time the temperature and the height of the barometer were recorded. The glass cylinder was then connected with a porcelain tube containing oxide of copper, and already heated to intense redness in a furnace, and the gas forced out of the cylinder by dry mercury. As the gas escaped

from the cylinder it was carried through the porcelain tube by a slow stream of nitrogen previously dried by suitable means.

The gas was thus burned completely to carbon dioxide and water which were collected and weighed by the usual methods, using a balance plainly sensitive to 1-10000 gram.

After the combustion, the glass cylinder was accurately calibrated by means of mercury at a known temperature, and thus was determined the exact volume of gas which had been burned.

As it appeared possible under the conditions of the method that some nitrogen might undergo an oxidation, the water produced in the combustion of the gas was carefully tested, but in no case was the water found to have an acid reaction.

In the above described method are determined the weights of carbon and hydrogen per unit volume of gas. In conducting the combustion great care was taken to secure complete oxidation, of the combustible constituents, and absorption of the products.

For the absorption of water, sulphuric acid of 1.71 Sp. Gr., followed by phosphoric anhydride, was used, and for the carbon dioxide a solution of caustic potash in glycerine.

For the determination of nitrogen the following method was employed: A porcelain combustion tube containing oxide of copper was brought to a yellow heat, and a stream of carbon dioxide conducted through the tube until the last traces of air were expelled.

The expulsion of the air was considered complete when it was found that the carbon dioxide escaping from the tube was wholly absorbed by a solution of caustic potash,—100 cubic centimeters of such gas not leaving a visible quantity unabsorbed by the alkaline solution. Then, after expulsion of the last traces of air, a quantity of natural gas (100 c. c. were generally employed), was allowed to flow slowly into the stream of carbon dioxide as it entered the combustion tube. In this manner the gas was burned and a mixture of nitrogen and carbon dioxide collected in a eudiometer over caustic potash solution. After the absorption of the carbon dioxide the volume of the residual

nitrogen was measured. This nitrogen was carefully tested for carbon dioxide, oxygen and carbon monoxide, and was frequently repassed through the heated combustion tube a second time and again measured, in order to insure the complete combustion of all hydro-carbons. This repetition demonstrated in all but one or two instances that the nitrogen was pure. It was found that with a sufficiently slow stream of gas the oxidation by the oxide of copper is easily rendered complete, although the rate of flow must be regulated with great care.

By the common eudiometric methods of analysis no determination is more difficult than that of nitrogen when occurring in small quantities in admixture with hydrocarbons of the paraffin series. In the method above described large quantities of gas can be employed, and the results are accurate.

The determination of free oxygen in natural gas cannot well be made with the quantity of gas commonly at disposal. A test was made in every instance in about 100 cubic centimeters of gas, using an Elliott apparatus, and as an absorbent a solution of caustic soda and pyrogallic acid. In all cases the results were negative.

I have found it necessary to conduct the tests for oxygen at the wells, and this was done in the following manner:

A slow stream of gas was caused to flow (directly from the well or main) successively through solutions of caustic potash and pyrogallic acid for 10 minutes, in order to expel dissolved air. Then by a simple contrivance the two fluids were mixed without interrupting the current of gas, which continued some time longer through the mixture. If the mixed fluids then exhibited a brown color, gradually increasing in depth, it was considered that the presence of oxygen was established.

The direct determination of free hydrogen has generally been considered a matter of such difficulty, that in many published analyses its quantity has been estimated by a calculation based upon the total carbon and hydrogen contained in the gas. For the present purpose a direct determination seemed very desirable and the process of Hempel has been used in the manner de-

scribed below. 100 cubic centimeters of gas, after the removal of carbon dioxide were washed with strong alcohol until the higher hydro-carbons, ethane, propane, &c., were removed. This was carried out in an Elliott apparatus, having a water jacket. Then the residual gas mixed with two or three times its volume of air, was passed over asbestos, coated with 30% of Palladium sponge at a temperature of °C.

By this treatment the hydrogen alone is burned, provided the higher paraffins, including ethane are previously removed by washing with alcohol. From the contraction in volume after passing the palladium, the proportion of free hydrogen is easily determined.

The method is very accurate when methane is the only hydro-carbon present. It is inaccurate in presence of ethane and the higher members of the series, and when these are present the washing with alcohol must be long continued. As it is a matter of great difficulty to retain hydrogen, even by the help of the most carefully ground stopcocks, the tests for this element were made in all cases at once after the arrival of the samples in the laboratory.

The olefines, as a group and carbon monoxide, are much more easily determined in natural gas than the paraffins and free hydrogen.

The olefines are quickly absorbed and removed by bromine water and carbon monoxide by a solution of cuprous chloride. These reagents are used in the order named. Unfortunately, however, these fluids are likewise solvents, in less degree, for the paraffins,—ethane, propane, &c. Hence a gas perfectly free from olefines and carbon monoxide is liable, on being washed with the above named fluids, to undergo a reduction in volume, leading to a wrong conclusion.

For the determination of these substances the following process was used, based on the solubility of both in a cuprous chloride solution. At the gas well a stream of gas was caused to bubble for two hours or more through 100 cubic centimeters of a solution of cuprous chloride. The solution was preserved for examination in the laboratory.

A quart flask, provided with a gas delivery tube and a funnel tube reaching to the bottom, was filled with boiled water and then the cuprous chloride, prepared as above described, was poured into the flask through the funnel tube. The flask was then heated to the boiling point and the water caused to boil for three hours. A small quantity of gas was invariably collected from the cuprous chloride solution by this treatment.

The gas so collected was transferred to an Elliott apparatus carefully tested for olefines, and carbon monoxide by bromine water and cuprous chloride solution. In this way the quantities of these two constituents in a very large quantity of gas could be collected in concentrated form, convenient for a qualitative test.

Carbon dioxide was determined by means of moist potash in a eudiometer over mercury, and also in the Elliott apparatus over water, by caustic potash solution. The latter method yields very correct results.

In addition to the determinations carried out in the laboratory, the gas at the well was caused to pass in a slow stream through lime water. The stream of gas was made approximately the same by using the same delivery tube, depth of lime water and shape of containing vessel, and by counting the number of bubbles per minute, and then noting the rapidity with which the lime water became milky.

For the detection of ammonia the gas at the well was caused to bubble through 100 c. c. of water, which had been carefully purified by distilling with addition of sulphuric acid and permanganate of potash. This water was afterwards tested by Nessler's solution, after the common method in use in the examination of drinking water, for ammonia.

The presence of exceedingly minute traces of ammonia could thus be shown with great accuracy. As solid masses of ammonium carbonate are reported to have been thrown out from the pipes leading from gas wells in the Murrysville field, this test seemed very important.

In the statement of the results of analyses all gas volumes are to be understood as "normal"—that is the volumes observed under different conditions of temperature and pressures are all reduced to zero, Centigrade, and 760 millimeters mercury pressure; and, where measured in a moist condition, are calculated as dry.

The temperatures were all measured by one and the same thermometer, of which the error was known from a comparison with the Yale Observatory standard. This thermometer was made by Green in New York, and is divided to 1-10 degrees centigrade.

The barometer used was made by Hicks, and indicated by vernier, changes of 1-1000 inch. The constant error of this barometer was ascertained by comparison with the standard barometer of the Signal Service department, in Washington.

In all cases of gas measurements in eudiometers, the observations were made by means of Grunow cathetometer, having a millimeter scale and vernier and reading easily to 1-20 millimeter.

The etched scales upon the eudiometer tubes, as commonly supplied, are often very incorrect, both as regards uniformity and total length of scale, and are unsuited for accurate measurements of pressures or volumes.

The glass cylinders containing the gas samples for combustion were calibrated at a temperature not differing by one degree Centigrade from the temperature at which the gas was measured for analysis. In this way the calculation of errors due to expansion and contraction of the glass vessels was rendered unnecessary. This necessitated repeated calibrations after nearly every combustion.

In the calculation of the results of analyses, the following plan was adopted:

The percentage of Carbon dioxide was determined volumetrically. Having failed to find carbon monoxide and olefines in any of the samples, they are necessarily left out of account in the calculation. Having found free hydrogen in only one

of the gas samples, and here in traces, (Speechley), it is also to be ignored in the calculations.

The quantities of carbon dioxide and water produced in the combustion of a known volume of gas was weighed. From the weight of the water the proportion of hydrogen in a unit volume of gas could then be calculated. The percentage volume of carbon dioxide contained in the gas being known, its weight was deducted from the weight of the total quantity obtained in the combustion. The difference in the quantity corresponding to carbon in the form of hydro-carbons. The nitrogen having been determined in a separate portion of gas, and the free hydrogen being also known, the volume of the hydrocarbons will be expressed by the following equation.

$$\text{C \& H in form of hydrocarbons} \rbrace = 100-(CO_2+N+H+\text{etc.})$$

That is to say that the actual volume of hydrocarbons will occupy the entire space in the gas not occupied by CO_2, N, H, O, and other constituents of the gas.

No attempt has been made to determine the proportion ot individual members of the paraffin series,—methane, ethane, propane &c., for the reason that no sufficiently accurate methods are known for the estimation of these bodies. No reagent can be named which will absorb and remove from a mixture any of these paraffins exclusively, so as to allow of its correct determination by difference.

In such a mixture, moreover, no decided chemical change can be produced in any given paraffin without more or less altering the others. They are remarkable for the resemblance existing between them in chemical relationships, and also for the great resistance which they offer towards reagents of every description, excepting chlorine which attacks them all readily.

Moreover a calculation of the relative proportions of the gaseous hydro-carbons of this class, based upon eudiometric data, is only possible where the number of such bodies is known to be limited to two,—a condition never to be assumed in a gas of unknown composition. In illustration of the fact just stated it may here be mentioned that a mixture of one volume each of

methane, ethane and propane yields, on complete combustion, the same products and in the same proportions as three volumes of the intermediate hydrocarbon ethane. This can be shown by a very simple calculation.

Selection of Samples.

It was originally proposed to take samples from mains drawing gas from a group of wells and in this way obtain an average of the entire group. This was sometimes done as in the case of the Raccoon Creek and Speechley territories, where a large number of wells, all producing from one sand, are joined to one main. In other fields the wells are often drilled to different sands and produce gas from different horizons as in the case of the Kane wells. In many cases, among a large number of productive wells, all but two or three are shut in, and are thus held in reserve. In such instances a sample was taken at a single well, and directly from the main at the well.

Of the samples examined, No. 1 was taken at Fredonia, N. Y., by Mr. E. J. Crissey, Secretary of the Fredonia Natural Gas Light Co., from the main of the company. All the other samples were collected by myself. In view of the great extent of the Pennsylvania gas territory, and the number of small areas of highly productive gas wells, the selection of samples with a view to an approximate average is a matter of no small difficulty. For the present purpose, and in the absence of any scientific criteria, reference has been made chiefly to the technical importance of certain regions, such as Murrysville and Speechley. Fredonia, N. Y., was chosen on account of the great depth (geologically) of the gas rock.

Wilcox gas is remarkable for the long maintained high pressure exhibited in certain wells.

Baden and Raccoon Creek lie on the same anticlinal.

Houston (Canonsburg) gas comes from a region 200 miles distant from the far northern Fredonia gas field. All the samples are from regions where natural gas is being largely utilized on account of its fuel value.

Description of Samples.

No. 1.—Fredonia, N. Y. From mains of the Fredonia Natural Gas Light Co., May 12th 1887.

Mr. E. J. Crissey, Secretary of this Company, furnishes the following information:

Gas is obtained at an average depth of 200 feet. The rock is black and gray shale, alternating, to the depth of about 1000 feet, where a limestone is found. No gas has been found below 250 feet until a depth of between 1700 and 1800 feet is reached, when gas and salt water are met. At 2250 feet gas is again found, which burns with a very white flame, whiter than that of the shallow gas. The sample examined comes from the depth of 200 feet.

Two determinations of nitrogen in this gas gave 9.58% and 9.50% respectively. Mean, 9.54%.

In two determinations of carbon dioxide there were found 0.38% and 0.44%. Mean, 0.41%.

Results of Analysis of Fredonia Gas.

Nitrogen	9.54 per cent
Carbon dioxide	0.41
Olefines	0
Carbon monoxide	0
Free hydrogen	0
Ammonia	0
Hydrocarbons of the paraffin series	90.05
	100.00

343.47 cubic centimeters of Fredonia gas yield on combustion, by the method already described:

H_2O—0.6254 gm., corresponding to H—0.06964 gm=21.83 per cent.
CO_2 0.9144 gm., corresponding to C—0.24938 gm=78.17 per cent.

100.00

Making allowance for the 9.95% of nitrogen and carbon dioxide contained in the gas, it is calculated that the 90.05% paraffins present contain

Per liter.—0.80627 gm. carbon.
0.22515 gm. hydrogen.

In a second combustion of Fredonia gas 326.17 cubic centimeters yielded.

H_2O—0.5927 gm., corresponding to H—0.0660 gm=21.89 per cent.
CO_2—0.8635 gm., corresponding to C—0.2355 gm=78.11 per cent.

100.00

As these quantities of carbon and hydrogen belong exclusively to the paraffins in the gas, it is calculated that the paraffins —amounting to 90.05% of the total gas, will contain

Per liter.—0.80185 gm. carbon.
0.2247 gm. hydrogen.

In these calculations, as in the following, an allowance is made in the determination of the carbon for the very small quantity of carbon dioxide which always occurs in the original gas.

The means of the two results above cited are per liter of paraffins,—

0.80406 gm Carbon=78.14 per cent.
0.22492 gm Hydrogen=21.86 per cent.

100.00

In the case of the Fredonia gas no tests were made at the wells. An actual test made at one of the wells in August, 1884, showed traces of oxygen. In the limited quantity at disposal for the above analysis no positively certain indication for oxygen could be obtained.

No. 2.—From valve house close to well No. 1, of the Sheffield Gas Co., ½ mile from Sheffield, Warren Co., Pennsylvania. Wells No. 1, 2 and 3 were connected with the main at the time, so that the sample represents the average of the three wells.

Well No. 1 has been flowing since 1875; No. 2 was drilled two years later; No. 3 in 1885. The gas comes wholly from one and the same sand. The record of No. 1 is given on page 23 of Mr. Carll's Report on Warren Co., for 1883.

The sand from which these wells produce gas is about 1400 feet deep, and very nearly at ocean level.

The Sheffield Company own six wells. In the newer wells the pressure is even greater than in No. 1.

The pressure in No. 1 has remained constant since it was drilled, and amounts to 550 lbs. in four minutes when the gas is shut in.

In the Sheffield region there are about 64 square miles of gas producing territory, and the gas pressure varies between 500 and 800 lbs. per square inch.

The Sheffield gas wells supply Sheffield, Iona, Brookston, Clarendon, Warren, Corry, Erie and Jamestown, N. Y.

The wells in this region have been remarkably persistent.

Determinations of	(1)	(2)	Mean.
Nitrogen	9.00	9.12	9.06 per cent.
Carbon Dioxide	0.33	0.27	0.30 per cent.

Results of Analysis of Sheffield Gas.

Nitrogen	9.06
Carbon doxide,	0.30
Oxygen	Trace
Hydrogen	0
Olefines	0
Carbon monoxide,	0
Ammonia	0
Paraffins	90.64
	100.00

305.27 cubic centimeters of Sheffield gas yield on combustion.

H_2O.—0.4960, corresponding to H,—0.05523 gm=23.36 per cent.
C.O_2—0.6645, corresponding to C,—0.18123 gm=76.64 per cent.

100.00

From these results it is calculated that the paraffins present in the Sheffield gas contain per liter:

0.65495 gm carbon.
0.19960 gm hydrogen.

In a second combustion 314.44 cubic centimeters of Sheffield gas yield:

H_2O.—0.5090 gm, corresponding to H,—0.05668 gm=23.27 per cent.
C. O_2—0.6851 gm, corresponding to C,—0.18684 gm=76.73 per cent.

100.00

The paraffins will therefore contain per liter:

0.65557 gm carbon.
0.19887 gm hydrogen.

The means of these two analyses are per liter of paraffins:

0.65526 gm carbon= 76.69 per cent.
0.19923 gm hydrogen=23.31 per cent.

100.00

No. 3.—Wilcox Gas Well, 3 miles from Wilcox, McKean Co. Sample collected Jan. 29, 1887. Originally known as "Wilcox well, No. 1," now called No. 7. Was drilled in 1878, and produces gas from the fourth sand exclusively.

This well was the first in this region and has maintained a continuous pressure of 500 lbs. when shut in.

The United Natural Gas Co. own 24 wells in the Wilcox field, which occupies an area of about 2 miles square, No. 1 being in the southwest end. All are very productive and some are remarkable for unusually high pressures, the gauge registering in one well 900 lbs. All exceed 500 lbs. Very little salt water is produced. The gas exhibits a decided oxygen reaction, turns lime water rapidly milky, and has a strong odor. Pipe lines carry the gas from these wells to Bradford, Jamestown, N. Y.; Hornellsville, Salamanca, Buffalo, but the supply is largely in excess of the demand at present.

Determinations of	(1)	(2)	Mean.
Carbon dioxide	0.21	0.20	0.21 per cent.

Results of Analysis of Wilcox Gas.

Nitrogen	9.41 per cent.
Carbon dioxide	0.21
Oxygen	trace.
Carbon monoxide,	0
Olefines,	0
Ammonia,	0
Hydrogen	0
Paraffins,	90.38
	100.00

374.2 cubic centimeters of Wilcox gas yield on combustion.

H_2O. – 0.6022 gm, corresponding to H,– 0.06706 gm=23.48 per cent.
C. O_2 – 0.8014 gm, corresponding to C,– 0,21856 gm=76.52 per cent.

100.00

Hence 1 liter paraffins contains:

0.64622 gm carbon.
0.19828 gm hydrogen.

In the case of the Wilcox gas, an accident to some of the sample vessels prevented a second combustion, so that but a single result can be presented.

No. 4.—Kane Well, No. 1, at Kane, McKean Co. Gas collected Jan. 30th 1887.

The well was drilled in 1884. The pressure then was 550 lbs. when shut in for 40 minutes. It was allowed to blow off for 8 months and then shut in, when the pressure increased to 630 lbs. This gain in pressure has been permanent, up to October, 1886, when the last test was made. The Kane Natural Gas Co. own two other wells in addition to this. The gas exhibits decided oxygen and carbon dioxide reactions.

Determination of	(1)	(2)	Mean
Nitrogen	9.67	9.91	9.79
Carbon dioxide	0.20	0.20	0.20

Results of Analysis of Kane Gas.

Nitrogen	9.79	per cent
Carbon dioxide	0.20	
Oxygen	trace	
Olefines	0	
Carbon monoxide	0	
Hydrogen	0	
Ammonia	0	
Paraffins	90.01	
	100.00	

349.03 cubic centimeters of gas yield on combustion.

H_2O.—0.5600 gm, corresponding to H,—0.06236 gm=23.18 per cent.
C. O_2—0.7580 gm, corresponding to C,—0.20672 gm=76.82 per cent.

100.00

Hence 1 liter of the paraffins contains:

0.65801 gm carbon.
0.19849 gm hydrogen.

248.1 cubic centimeters of the same gas yield on combustion.

H_2O.—0.3987 gm, corresponding to H,—0.04439 gm=23.28 per cent.
$C.O_2$—0.5366 gm, corresponding to C,—0.14634 gm=76.72 per cent,

100.00

Hence the paraffins of Kane gas contain per liter:

0.19883 gm hydrogen.
0.65537 gm carbon.

The means of these two analysis are per liter of paraffins.

0.65669 gm carbon = 76.77 per cent.
0.19866 gm hydrogen = 23.23 per cent.

100.00

No. 5.—Speechley. This field has been a remarkably productive one, as regards quantity and pressure of gas and number of wells. These wells are situated on a N. E. & S. W. line about 6 miles S. E. from Oil City.

The sand rock from which the gas is obtained averages 1900 feet in depth, and is about 900 feet below the third oil sand of Venango county.

This latter sand also produces gas, but in much smaller quantity, and it is consequently cased off, so that the gas in this territory is wholly obtained from one and the same sand rock. The Northwestern Gas Co. of Oil City has 60 wells, and a large number of wells are owned by other companies.

The samples of gas for examination were taken April 13th 1887, from the high pressure main at South Oil City, belonging to the Northwestern Natural Gas Co. At this time the pressure in the main was 100 lbs.

This sample may be considered to represent approximately the average of the gas from a large number of wells.

The tests at the main indicated the presence of oxygen, but less of carbon dioxide than found in the Warren and McKean County gas.

Determinations of	(1)	(2)	Mean.
Nitrogen	4.61	4.41	4.51 per cent.
Carbon dioxide	0.05	0.05	0.05
Hydrogen	0.02	0.02	0.02

Results of Analysis of Speechley Gas.

Nitrogen	4.51	per cent.
Carbon dioxide	0.05	
Hydrogen	0.02	
Carbon monoxide	0	
Olefines	0	
Oxygen	trace	
Ammonia	0	
Paraffins	95.42	
	100.00	

304.24 cubic centimeters Speechley gas yield on combustion.

H_2O,—0.5423 gm, corresponding to H,—0.06039 gm=22.93 per cent.
$C.O_2$—0.7441 gm, corresponding to C,—0.20293 gm=77.07 per cent.

100.00

Hence the paraffins of this gas contain per liter

0.69900 gm carbon
0.20801 gm hydrogen.

In a second combustion of the same gas, 310.52 cubic centimeters yield

H_2O,—0.5500 gm, corresponding to H,—0.06125 gm=22.85 per cent.
CO_2,—0.7585 gm. corresponding to C,—0.20686 gm=77.15 per cent.

100.00

Hence the paraffins contain per liter:

0.20671 gm Hydrogen.
0.69815 gm Carbon.

In a second combustion 306.28 cubic centimeters of gas yield

H_2O,—0.4818 gm. corresponding to H —0.05365 gm=25.02 per cent
CO_2,—0.5895 gm. corresponding to C,—0.16074 gm=74.98 per cent.

100.00

The mean of these two results are per liter of paraffins:

0.69857 gm carbon = 77.11 per cent.
0.20736 gm hydrogen = 22.89 per cent.

100.00

No. 6.—Hukill Well, on the Dick farm, Lyons Run District,

southern end of the Murrysville field, and one of 60 wells belonging to the Philadelphia Company.

This well was drilled in 1883 and was allowed to blow off for a long time. The well is very productive and has a pressure as it flows through the main of 285 lbs.

The well has extra heavy casing and there is good reason to suppose that the gas comes exclusively from the Murrysville sand. The sample was taken April 8, 1887.

The gas produces a decided carbon dioxide reaction but exhibits a very slight reaction for oxygen.

This gas has a very faint odor, free from the pungent character noticed among some of the gas samples. The wells yields no oil, but a very little salt water.

Determinations of	(1)	(2)	Mean.
Nitrogen	2.13	1.91	2.02 per cent.
Carbon dioxide	0.26	0.30	0.28 per cent.

Results of Analysis of Murrysville Gas.

Nitrogen	2.02 per cent
Carbon dioxide	0.28
Oxygen	trace
Carbon monoxide	0
Olefines	0
Ammonia	0
Hydrogen	0
Paraffins	97.70
	100.00

346.94 cubic centimeters of Murrysville gas yielded on combustion.

H_2O,—0.5473 gm. corresponding to H,—0.06095 gm=25.06 per cent.
CO_2,—0.6682 gm. corresponding to C,—0.18224 gm=74.94 per cent.

100.00

Hence the paraffins in Murrysville gas contain per liter:

0.53763 gm Carbon.
0.17981 gm Hydrogen.

In a second combustion 306.28 cubic centimeters of gas yield:

H_2O,—0.4818 gm. corresponding to H,—0.05363 gm=25.02 per cent.
CO_2,—0.5895 gm. corresponding to C,—0.16074 gm=74.98 per cent.

100.00

Hence the paraffins contain per liter:

0.53718 gm Carbon.
0.17922 gm Hydrogen

The means of above analyses are per liter of paraffins:

0.53741 gm Carbon = 74.96 per cent.
0.17950 gm Hydrogen = 25.04 per cent.

100.00

The following experiments were tried at the valve house of the Philadelphia Company, in the rear of the office building on Penn Street, Pittsburg, beginning on March 22d 1887. A Woulfe's bottle containing 200 c. c. purified water, and a second bottle containing cuprous chloride were connected with a gas meter, and gas allowed to stream slowly through them until 190 cubic feet had passed. The gas thus used comes directly from the Murrysville field. The gas was passed very slowly, so that 3 days were occupied in the transmission of the volume above named. The water was then tested for ammonia by Nessler's reagent. No trace could be detected, although as is well known this reagent is capable of detecting 1-200000000 part of ammonia in water, with great certainty.

The cuprous chloride was tested for both olefines and carbon monoxide by the method I have detailed, but no trace could be detected of either.

The composition of methane gas by weight is

Carbon, ... 74.97 per cent.
Hydrogen, ... 25.03 per cent.

100.00

Hence this Hukill well produces gas approximating in composition to pure methane, and in this respect differs from all those from which samples have been taken. It may be here stated that at the time the sample was collected there was every

reason to believe that the gas came exclusively from this one well.

No. 7.—*Raccoon District.*

The sample was taken May 2d, 1887, from the high-pressure main of the Bridgewater Natural Gas Co. at Rochester, Pa. The pressure at the time was 67 lbs.

The gas is produced wholly from one sand, which is about 1200 feet below the surface on Raccoon Creek, in Beaver County The Bridgewater Company owns 23 wells and supplies the towns of Beaver Falls, Rochester, New Brighton, Phillipsburg, Vanport, Bridgewater, New Sheffield, Shannopin.

The Youngstown Company owns 12 wells in the same region. The gas is almost odorless, and the wells produce little or no salt water, and no oil.

On causing the gas to bubble through lime water for 20 minutes the fluid remained perfectly clear. After 40 minutes a rapid stream of gas caused the lime water to become faintly milky, as seen in a bright light. The proportion of carbon dioxide was far too small to allow an accurate eudiometric determination. The oxygen reaction was faint but decided.

This gas on being passed for one hour into a nitrate of silver solution produced a faint but decided reaction, indicating a trace of sulphuretted hydrogen.

In the statement below, the result of the carbon dioxide test at the main is given.

Determination of	(1)	(2)	Mean.
Nitrogen	10.00	9.82	9.91

Results of Analysis of Raccoon Creek Gas.

Nitrogen	9.91	per cent.
Hydrogen	0	
Carbon dioxide	trace	
Carbon monoxide	0	
Olefines	0	
Oxygen	trace	
Ammonia	0	
Sulphuretted hydrogen	trace	
Paraffins	90.09	
	100.00	

In a combustion of Raccoon Creek gas 325.48 cubic centimeters yielded:

H_2O,—0.5108 gm, corresponding to H,—0.05688 gm=23.60 per cent.
CO_2,—0.6755 gm, corresponding to C,—0.18422 gm=76.40 per cent.

100.00

Hence the paraffins in this gas contain per liter:

0.62827 gm carbon.
0.19398 gm hydrogen.

In a second combustion 398.08 cubic centimeters gas yielded.

H_2O,—0.6254 gm, corresponding to H,—0.06964 gm=23.56 per cent.
CO_2, 0.8286 gm, corresponding to C,- 0.22598 gm=76.44 per cent.

100.00

Hence the paraffins contain per liter:

0.63010 gm carbon.
0.19418 gm hydrogen.

The means of these two results are per liter paraffins:

0.62918 gm carbon = 76.42 per cent.
0.19408 gm hydrogen = 23.58 per cent.

100.00

This is the only gas which contains traces of sulphuretted hydrogen among those I have examined.

No. 8.—Baden, six miles S. E. from Rochester on the Pittsburg, Fort Wayne and Chicago R. R., Beaver County. The samples were taken May 18th 1887, from the Bryan well No. 2, one of the four wells belonging to the Baden Gas Co. The gas is produced wholly from one sand which is 1396 feet deep, or about 1300 feet below the Ohio river. This well was drilled in May, 1886.

The Baden wells are on the same anticlinal axis as the Raccoon Creek wells. This same axis continues northward a few miles east of the Speechley wells near Oil City.

The gas exhibits a decided carbon dioxide and also an oxygen reaction.

Determinations of	(1)	(2)	Mean.
Nitrogen	12.26	12.38	12.32 per cent.
Carbon dioxide	0.41	0.41	0.41

Results of Analysis of Baden Gas.

Nitrogen	12.32 per cent.
Carbon dioxide	0.41
Oxygen	trace
Hydrogen	0
Carbon monoxide	0
Olefines	0
Ammonia	0
Paraffins	87.27
	100.00

317.17 cubic centimeters of Baden gas yield on combustion:

H_2O,—0.4892 gm, corresponding to H,—0.05447 gm=23.48 per cent.
CO_2.- 0.6510 gm, corresponding to C, 0.17754 gm=76.52 per cent.

100.00

Hence the paraffins of Baden gas contain per liter:

0.64142 gm carbon.
0.19681 gm hydrogen.

In a second combustion 332.70 cubic centimeters yield:

H_2O,—0.5130 gm, corresponding to H,—0.05712 gm=23.56 per cent.
CO_2 0.6843 gm; corresponding to C,—0.18663 gm=76.44 per cent.

100.00

Hence the paraffins contain per liter:

0.64276 gm carbon.
0.19674 gm hydrogen

The means of these two results are per liter paraffins:

0.64209 gm carbon = 76.48 per cent.
0.19677 gm hydrogen = 23.52 per cent.

100.00

No. 9.—*Houston Well,* Houston Station, 2 miles south of Canonsburg, on the Pittsburg, Cincinnati and St. Louis R. R. Washington County.

This well is situated 1-3 mile west of the station on Plum Run.

It is drilled nearly through the Gantz sand and is 1794

feet deep. An upper, gas producing sand is found at 850 feet, but this is cased off so that the well may be considered to yield gas from the Gantz sand exclusively.

The gas from the upper sand is said by well superintendents to burn with a whiter but more sooty flame than that from the greater depth.

According to the statements generally heard at the wells, the occurrence of an upper, less productive gas sand, yielding gas of greater illuminating power, is a very common feature in the many gas fields. The sample was collected on March 18, 1887.

The gas exhibits an oxygen reaction and causes a rapid precipitation in lime water.

Determination of	(1)	(2)	Mean
Nitrogen	15.23	15.37	15.30 per cent.
Carbon dioxide	0.42	0.46	0.44 per cent.

Results of Analysis of Houston Gas.

Nitrogen	15.30 per cent.
Carbon dioxide	0.44
Oxygen	trace
Olefines	0
Carbon monoxide	0
Ammonia	trace
Hydrogen	0
Paraffins	84.26
	100.00

310.20 cubic centimeters of Houston gas yielded on combustion

H_2O,—0.4601 gm, corresponding to H,—0.05124 gm=23.20 per cent.
CO_2,—0.6217 gm, corresponding to C,—0.16955 gm=76.80 per cent.

100.00

Hence the paraffins contain per liter:

0.64871 gm carbon.
0.19602 gm hydrogen.

In a second combustion 293.35 cubic centimeters yielded:

H_2O,—0.4392 gm, corresponding to H,—0.04891 gm=23.44 per cent.
CO_2,—0.5855 gm, corresponding to C,—0.15968 gm=76.56 per cent.

100.00

Hence the paraffins contain per liter:

0.64604 gm carbon
0.19786 gm hydrogen.

The means of these two analyses are per liter of paraffins:

0.64737 gm carbon	=	76.68	per cent.
0.19694 gm hydrogen	=	23.32	per cent.
		100.00	

The analyses above detailed were carried out with great care, and every known precaution observed in order to secure accuracy.

The results represent the character of the gas from particular wells or groups of wells, scattered over a large region. and as it flowed from the wells on a single day.

It is questionable whether they can be considered to represent the average composition of natural gas, for the reason that the gas territory is so vast in extent.

According to the above results natural gas is not so complex a substance as has been heretofore supposed.

The samples examined may be said to consist mainly of the hydro-carbons of the paraffin series, among which methane predominates.

It is to these bodies that the fuel value of the gas is due.

Inasmuch as the most of the gas conveyed through pipe lines, deposits little or no liquid hydro-carbons, it is evident that the higher paraffins are not present in notable quantity.

The method I have used in testing for the hydro-carbons of the olefine series enables me to state with much confidence that these bodies,—ethylene, propylene, butylene, etc., are absent. Hydrogen I have found in Speechley gas alone, although the utmost care has been taken in the examination.

Perhaps still smaller quantities may have escaped detection in other gas samples.

Sulphuretted hydrogen was found only in Raccoon Creek but in faint traces.

Oxygen is present in all, but in such small quantities that

I have never succeeded in accurately determining its real percentage.

As nearly as I can estimate, the Wilcox contains more oxygen than any other, and Murrysville the least.

Ammonia was found, in traces only, in Houston gas. Carbonic oxide was not found in any of the samples.

A comparison of the results in the accompanying table shows that the different gas samples differ mainly in the following particulars.

1.—The proportion of carbon to hydrogen in the contained paraffins—that is to say the ratio of the lower to the higher paraffins. Fredonia is seen to be the richest gas in carbon.

2.—The proportion of nitrogen, which varies between 2.02% and 15.30%. The three gas fields, Speechley, Baden and Raccoon Creek approximately on the same anticlinal (according to Mr. I. C. White) produce gas having very different quantities of nitrogen.

The resemblance between Fredonia, Sheffield, Kane, Wilcox and Raccoon Creek gas as regards the proportion of nitrogen is a matter of interest, although not explainable.

In the case of Murrysville, Speechley and Fredonia gas, the density, richness in carbon, and calorific power of the contained paraffins are inversely as the proportion of nitrogen. It is a curious fact that there is a certain continuity as regards composition in the case of the Fredonia, Kane, Sheffield and Wilcox gases, which disappears on reaching the Speechley field, in proceeding southward. South of Speechley much greater differences occur.

3.—The carbon dioxide, which varies within very narrow limits. The only gas in which it almost disappears is that from Raccoon Creek although Speechley gas contains barely more than a trace.

CONSTITUENTS	Fredonia	Sheffield	Kane	Wilcox	eechley	Lyon's Run, near Murrysville	Raccoon Creek	Baden	Houston
Nitrogen	9.54	9.06	9.79	9.41	4.51	2.02	9.91	12.32	15.30
Carbon dioxide	0.41	0.30	0.20	0.21	0.05	0.20	trace	0.41	0.44
Hydrogen	0	0	0	0		0	0	0	0
Ammonia	------	0	0	0	0	0	0	0	trace
Oxygen	trace	trace	trace	trace	trace	trace	trace	trace	trace
Sulphuretted hydrogen	------	0	0	0	0	0	trace	0	0
Paraffins	90.05	90.64	90.01	90.38	95.42	97.70	90.09	87.27	84.26
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
The paraffins contained in these gas samples have the following composition *by weight.*									
Carbon	78.14	76.69	76.77	76.52	77.11	74.96	76.42	76.48	76.68
Hydrogen	21.86	23.31	23.23	23.48	22.89	25.04	23.58	23.52	23.32
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

At Oil City a sand is found 582 feet below low-water mark in the Allegheny River, which produces gas of lower pressure, amounting, it is said, to 20 lbs. when shut in for some time. This gas is used in the Oil Well Supply Co.'s works for heating purposes. It bears the same relation to the Speechley gas sand—1900 feet deep—as the shallow gas sands usually to the the deeper, and more productive sand rocks.

A determination of the nitrogen in the gas from this upper rock gave 5.62 per cent. Speechley gas contains 4.51 per cent. The sample was collected on April 13th, the day on which the Speechley samples were taken.

The Speechley gas wells are six miles distant from this well. Tests for hydrogen, olefines, carbon monoxide and dioxide and ammonia in this gas all led to negative results.

Calculation of the Fuel Value of Natural Gas.

The calorific power of any combustible may be determined by measuring the number of kilograms of water heated from 0° to 1° C. by 1 kilo of the fuel in burning, or by a calculation.

The difficulties and inconveniences encountered in the first method necessitate commonly a resort to the second.

Pure charcoal in burning produces, according to the researches of Favre & Silbermann (in 1849), 8080 heat units, or 1 kilo in burning will raise the temperature of 8080 kilos of water from 0° to 1° C.

By the same authors it was found that 1 kilo of hydrogen in burning generates a quantity of heat sufficient to warm 34462 kilos of water from 0° to 1° C.—that is 34462 heat units. Later determinations have been made by various authors, the most important by Thomsen, who found 34180 (Berichte der Deutschen chemischen Gesellschaft, 1873, p. 1533), and by Berthelot who obtained the number 34600, (Comptes Rendus, 1880 p. 1240). The value assigned by Thomsen, viz: 34180, is probably the more correct.

If it were possible that a fuel should contain pure hydrogen and charcoal, *uncombined,* a calculation of its heating power would lead to very correct results. It is found, however, that when a *compound* of carbon and hydrogen is burned, the number of heat units produced will not equal the number obtained when the same quantities of carbon and hydrogen are burned separately.

Thus a kilo of methane produces 13270.5 heat units, but if the same quantities of carbon (as charcoal) and hydrogen were burned *separately* in a calorimeter, 14613 heat units result (assuming that the carbon produces 8080, and the hydrogen 34180 heat units per kilo burned).

The difference between the calculated amount of heat, and, the actually available heat—14613—13270=1343 heat units is 9.19 per cent. of the theoretical yield. For practical applications this is a loss of heat, which must be considered to represent the quantity of energy required to overcome the mutual affinity of the carbon and hydrogen which are to be first separated, before they are burned to carbon dioxide and water.

With more complex compounds the available heat of combustion does not fall so far short of the theoretical maximum,

and it may be stated in a general way that the greater the number of carbon atoms in the compound, the more closely will the available and actual number of heat units coincide. This statement is especially true of certain series of hydro carbons. The following table (II) will serve to illustrate this in the case of the first three members of the paraffin series. For the higher paraffins no determinations have yet been made.

TABLE II. Showing ratio of available to calculated heat of combustion in the case of certain hydrocarbons.

NAME	SYMBOL	Calculated heat units, assuming that the carbon and hydrogen produce the maximum of heat, and are burned separately. Per kilo of paraffin.	Available heat as determined by calorimetric measurement. Per kilo of paraffin.	Percentage of available on theoretical maximum of heat units.
Methane	$C\ H_4$	14613	13270	90.81
Ethane	$C_2\ H_6$	13310	12373	92.95
Propane	$C_3\ H_8$	12835	12052	93.89

It has been shown by Thomsen that isomeric hydro carbons, or those which differ in properties, although having identical composition may produce different quantities of heat when burned, thus:

	Symbol	Heat Units
Propylen	$C_3\ H_6$	11757
Trimethylene	$C_3\ H_6$	10917
Difference		840

The chemical formulas given show them to have the same composition, and yet these hydrocarbons would be represented by different values if used as fuels.

The presence of isomers among the hydro carbons of natural gas would tend to interfere with the correctness of a calculation of its fuel value.

No isomers are known in the case of methane (CH_4).

Berthelot has stated that a second hydro carbon isomeric with ethane (C_2H_6) exists, which produces on burning 12776 heat units, instead of 12373, the number as determined by Thomsen.

Thomsen's researches have disproved this assertion, however, and have shown conclusively that ethane produced in a variety of ways invariably possesses the same calorific power. (Berichte der Deutschen chemischen Gesellschaft 1881, p. 500). Isomers of the higher paraffins no doubt occur in gas, as well as in petroleum, but when it is considered that in gas the higher paraffins occur only in small quantity, and moreover that the calculated and the available calorific power differ much less in these higher members than in methane and ethane, the danger of error from the presence of such isomers cannot be considered likely to affect the calculated results.

The calorific power of methane was determined by Andrews in 1848 as 13108 heat units (Philosophical Magazine 1848 p. 321), and by Favre and Silbermann in 1853 as 13063 heat units.

In 1880 Thomsen assigned it the value of 13345.6 and this number agrees closely with that obtained by Berthelot in the same year viz: 13343.8. More recently Thomsen has corrected his former result and now gives 13270.5 as the most probable number. (Berthelot, Comptes Rendus, 1880 p. 1240. Thomsen, Berichte der Deutschen Chemischen Gesellschaft 1880 p. 959 and 1321 Ref. and 1886 p. 77 Ref.)

The elaborate researches of Julius Thomsen in thermochemistry, (Thermochemische Untersuchangen, Leipzig) have reached the fourth of a series of large volumes and although designed primarily as a contribution to theoretical chemistry, they supply data likely to prove of great value in the study of fuels for metallurgical and other technical purposes.

The actual calorific power of a gas fuel may now, by the use of such data, be more satisfactorily determined by calculation, provided its composition is known, than by the use of a calorimeter. In this respect there is an important difference between gas fuels and various kinds of coal. Coal being a compound of carbon, hydrogen and oxygen, of a highly complex character, or possibly a mixture of such compounds, no such plainly definable relationship exists between the theoretical maximum and the available heat quantity per unit weight burnt.

The percentage composition by weight of the paraffins likely to occur in natural gas is expressed in the following table. Small quantities of condensable vapors of the higher paraffins occur in the gas in some places as is evidenced by the condensation of benzene in pipes. These heavier vapors occur usually in very minute quantity, if at all:

TABLE III. Showing the Composition by weight of some of the Lower Paraffins..

NAME	Symbol	Per cent. Carbon.	Per cent. Hydrogen.
Methane	$C\,H_4$	74.97	25.03
Ethane	$C_2\,H_6$	79.96	20.04
Propane	$C_3\,H_8$	81.78	18.22
Butane	$C_4\,H_{10}$	82.72	17.28
Pentane	$C_5\,H_{12}$	83.29	16.71

The analyses of natural gas above detailed show a variation in the proportion of carbon and hydrogen in the case of the two extremes of 3.18 per cent., thus:

The paraffins in Murrysville gas contain—

Carbon	74.96 per cent. by weight.
Hydrogen	25.04 per cent. by weight.
	100.00

And in the case of Fredonia gas—

Carbon	78.14 per cent. by weight.
Hydrogen	21.86 per cent. by weight.
	100.00

From the tabular statement of the composition of the lower paraffins, it appears that Murrysville gas, as obtained at the Hukill well, has nearly the composition of methane, while disregarding again the nitrogen and carbon dioxide present, the Fredonia gas, the richest in carbon, approximates in composi-

tion to a mixture of equal volumes of methane and ethane, of which the actual composition would be, by weight:

Carbon	78.22 per cent.
Hydrogen	21.78 per cent.
	100.00

By this I do not imply that it actually contains these two paraffins in the proportion named, for it is possible that the gas in question contains more methane and a very small quantity of some one of the higher paraffins, propane or quartane, etc.

As I have stated in regard to the analyses, the exact determination of the percentage of individual paraffins is a matter of such extreme difficulty, that it may be considered practically impossible.

If we assume that Fredonia gas really contains equal volumes of methane and ethane, and calculate its calorific power accordingly, the following error may be committed. The gas may contain a larger amount of methane than was assumed, and consequently a very small quantity of quartane or pentane, *for although the percentage of carbon and hydrogen is definitely fixed by the analysis, it is still a question as to the arrangement of the carbon and hydrogen in the form of higher or lower paraffins.*

As the difference between the available and the theoretical heat of combustion is greater in the case of methane and less in the higher paraffins, an under estimate of the quantity of methane would lead to too high a value for the available heat of combustion. On the other hand, an under estimate of the proportion of the higher paraffins, would cause the available heat as expressed in heat units to be rated too low, supposing that in both cases the absolute quantities of carbon and hydrogen remain constantly the same.

This error would be small in most instances, but in the extreme case of two gases consisting of methane and ethane respectively, the error from this source would exceed 1%. I have attempted to correct this error, as will be shown below. The curious and intimate relationships of the paraffins are well

illustrated by the fact that a mixture of one cubic meter each of methane, ethane and propane will contain the same proportions of carbon and hydrogen, and will consequently yield the same quantities on burning of CO_2 and H_2O as three cubic meters of the intermediate hydro-carbon, ethane,—

1 cubic meter of methane weighs 0.714[illegible] kilo, and generates heat units	9485
1 cubic meter of ethane weighs 1.34016 kilo, and generates heat units	16582
1 cubic meter propane weighs 1.9656 kilos, and generates heat units	23688
	49755
3 cubic meters of ethane generate on burning heat units.......	49746
	9

The numbers expressing the heat produced are obtained by multiplying the weight of the cubic meter by 13270, 12373 and 12052, respectively, as given in table II.

The difference is so slight—amounting to only 9 heat units, that it is evident it would have been sufficiently accurate to assume this mixture of three hydro-carbons to consist of the intermediate member of ethane in so far as the calculation of the fuel value is concerned.

Or it may be more broadly stated, that, with a view to the calculation of the calorific power of natural gas, it is sufficiently accurate to assume that a natural gas (containing no hydro-carbons of the olefine series) has the simplest constitution consistent with its percentage by weight of carbon and hydrogen, and then to determine its fuel value accordingly.

Fredonia gas, as shown in the table of analyses, consists of 90.05% of paraffins, together with 9.54% nitrogen and 0.41% carbon dioxide. The paraffins consist of 0.80423 kilo carbon and 0.22494 kilo hydrogen per cubic meter.

The theoretical maximum of heat units for these paraffins is calculated as follows, per cubic meter:

0.80406×8080	6497
0.22494×34180	7288
	13785

When CH_4 burns, only 90.81% of the theoretical heat is available. When C_2H_6 burns, 92.95% can be utilized.

Hence if Fredonia gas is to be looked upon as a mixture of equal volumes of the two hydro-carbons methane and ethane, it will contain about 1 and 1.87 parts by weight respectively, (or approximately two parts by weight) of methane and ethane.

The available heat of combustion can be determined by multiplying the theoretical maximum by a factor which is intermediate between 90.81-100 and 92.95-100, and as a very close approximation the fraction

$$\frac{2\ Et + Mt}{3 \times 100}$$

will, I think, be sufficiently accurate. In this Et.= the percentage of available on theoretical maximum heat, for ethane and Mt.= the same ratio for Methane.

Substituting in this fraction

$$\frac{2 \times 0.9295 + 0.9081}{3} = .9224.$$

The theoretical maximum heat of combustion of the Fredonia gas, as calculated above, is 13785 heat units per cubic meter of contained paraffins.

Then $13785 \times 0.9224 = 12715$ as the available heat units due to the paraffins in the gas. As there are 90.05% of paraffins, the remainder, consisting of nitrogen and carbon dioxide, the above number will be still further reduced, and $12715 \times 0.9005 = 11450$,=the available heat produced, by one cubic meter of Fredonia gas.

In the case of the gas from Sheffield, Kane, Wilcox, Raccoon Creek, Baden and Houston, there is a general similarity as regards the percentage of carbon and hydrogen. Wilcox gas may be regarded as representing approximately the average,

and as a calculation shows that a mixture of 4 volumes methane and 1 volume ethane, contains carbon 76.54 and hydrogen 23.46, we may, for the purpose of the present calculation, assume that the above mentioned six gases contain approximately these proportions of the two named paraffins. For such a mixture, a factor by which to obtain the available calorific value will be

$$\frac{2\ \mathrm{Mt}+\mathrm{Et}}{3\times 100}=0.9153.$$

This factor has accordingly been used in the case of the above named gases. Speechley gas may be considered to contain 5 volumes of Methane and 2 volumes of Ethane for the purpose of the present calculation, and the factor will be

$$\frac{3\ \mathrm{Et}+4\ \mathrm{Mt}}{7\times 100}=0.9173.$$

Murrysville gas contains nearly pure methane, and consequently the factor will be 90.81.

It is not implied in the above considerations that the actual proportions of what may be regarded as the most commonly occurring paraffins—CH_4, C_2H_6, C_3H_8, etc., can be accurately stated, for this I believe to be impossible. These proportions have been assumed as not inconsistent with the analytical data, merely for the purpose of obtaining an approximately correct value for the factor to be used in the calculation of the calorific power of the gas. The following table (IV) contains the results of the calculations carried out as explained. Column No. 2 in this table expresses the quantities of carbon and hydrogen contained in one cubic meter of the paraffins in each gas. In Column No. 3, are given the factors, the derivation and use of which have already been pointed out:

TABLE IV.—Fuel Values of Natural Gas.

GAS FIELD.	Weight in Kilograms per cubic meter of paraffins.		Factor	Available heat units per cubic meter of gas	Available heat units per 100 cubic feet of gas	Pounds of water at boiling point evaporated by 100 cubic feet of gas	Pounds of pure charcoal equal in heating effect to 100 cubic feet by gas
	Carbon	Hydrogen					
Fredonia	0.80406	0.22492	0.9224	11449	32421	133.30	8.845
Sheffield	0.65526	0 19924	0.9152	10040	28430	116.89	7.756
Kane	0.65669	0.19866	0.9152	10354	29319	120.54	7.999
Wilcox	0.64622	0.19828	0.9152	9925	28102	115.54	7.667
Speechley	0.69857	0.20736	0.9173	11144	31554	129.73	8.609
Lyon's Run, near Murrysville	0.53741	0.17950	0 9081	9296	26321	108.22	7.181
Raccoon Creek	0.62918	0.19408	0.9152	9661	27355	112.47	7.463
Baden	0.64209	0.19677	0.9152	9515	26941	110.77	7.350
Houston	0.64737	0.19694	0.9152	9224	26119	107.38	7.126

This factor is a fraction. Its numerator represents the actual number of heat units produced in the burning of the unit weight of the total paraffins, from a consideration of the percentage of carbon and hydrogen in the gas. The denominator represents the number of heat units obtained when the quantities of contained carbon and hydrogen are multiplied by the numbers 8080 and 34,180 respectively, and the products added.

Column No. 4 gives the actual fuel value of each gas expressed in heat units per cubic meter. These numbers represent the heat of combustion calculated for the carbon and hydrogen separately, these two added together, and their sum multiplied by the corresponding factor in column No. 3.

The numbers in column No. 5 indicate kilograms of water which can be warmed from 0° to 1° C, when 100 cubic feet of the respective gas measured at 0° C. and under a barometric pressure of 76 centimeters, is burned at an initial temperature of 18° C, or 64.4° F; (this last is the temperature assumed by Thomsen in

his determinations,) and assuming that the products of combustion are liquid water and gaseous carbon dioxide.

In column 6 are stated the number of pounds avoirdupois of water which, theoretically should be boiled away at 100° C. into steam at the same temperature, and under atmospheric pressure, when 100 cubic feet of gas are burned. The latent heat of evaporation of water in this calculation has been assumed as 536.2 heat units. (Berthelot, Comptes Rendus, 1877, p. 646.)

In the seventh column a comparison is given between gas and pure charcoal, assumed free from ash.*

Charcoal has been chosen rather than coke or coal, for the reason that exact calorimetric data as to the latter fuels are as yet difficult to obtain, and calculated values are uncertain.

An impression prevails, based partly upon analytical data and partly upon a supposed variation in the steam producing power, that natural gas is subject to constant fluctuations in composition. To what extent such fluctuations are liable to affect the value of the results of the above calculations, I am wholly unable to state.

In conclusion I have to express my indebtedness for information and for facilities in conducting tests and examinations at wells to the following gentlemen: Mr. K. Chickering, of the Oil Well Supply Co., Oil City; Mr. W. C. Henry of the United Natural Gas Co., Wilcox; Mr. Walter Horton and Mr. John McNair, of Sheffield; Mr. J. D. Bruder, of Kane; Mr. E. J. Crissey, of Fredonia; Mr. T. F. Gayley, of Rochester, and to the officers of the Philadelphia Gas Co., the Baden Gas Co. and the Pennsylvania Gas Co. of Pittsburg, and to many others.

These results of Prof. Phillips show a larger proportion of Nitrogen than that obtained by chemists in more recent analyses, and in order to get comparative data, a series of careful analyses

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*As already stated the heat unit employed in the above calculations is the quantity of heat required to warm one kilogram of water from 0° to 1° C

The plan of statement of results I have adopted will render it an easy matter, however, to substitute any other units or calorimetric values.

have been made from several sources in the laboratory of the West Virginia Agricultural Experiment Station. These analyses were very carefully made under the direction of Prof B. H. Hite, the Chief Chemist of the Survey, by Prof. C. D. Howard, Associate Chemist of the West Virginia Agricultural Experiment Station.

Morgantown is supplied with gas by direct lines from the wells to the city operated under the natural pressure from the gas itself, or what is called the rock pressure (originally 550 pounds to the square inch, but now reduced to about 250. The gas is all derived from the Big Injun Sand, and as it comes direct from the wells through closed pipes to the Laboratory, there is no chance for contamination, and since the greatest care was exercised in the analysis by a very skillful chemist, the results in this case might be said to form a *standard* for comparison with other analyses. The fact that this one differs but slightly from that of the other samples which were transported to the Laboratory in properly closed bottles, gives much confidence in all of the results, and hence the composition here shown may be regarded as an *average* for West Virginia Natural Gas.

The interesting and explanatory letter of Dr. Howard, transmitting his analyses, and the tabulated analyses themselves are here given as follows:

"Morgantown, June 30, 1904.

Dr. I. C. White,
State Geologist.
Dear Sir:

Enclosed are the analyses of natural gas from six different sources, viz.: Morgantown supply, Fairmont supply, Shinnston supply, (Gordon sand), Big Injun well, Fifth sand well and Fifty-foot Sand well at Shinnston.

Considerable time and thought has been given to this work and a great many analyses made. In view of the large proportion of paraffine hydrocarbons and the very small proportion of other constituents present, the accurate analysis of these gases was found to be no simple matter. Even with all the precautions that

could be observed, with the apparatus and means at hand, it was found to be utterly impracticable to attempt making burette readings closer than 0.1%.

Carbon dioxide. This constituent was found to be almost entirely lacking in the gases examined. Special determinations by barium hydrate on large volumes of the Morgantown gas gave a mean of only 0.006%, which was less than the atmosphere of the laboratory contained at the time test was made.

Carbon monoxide. The amount of this constituent is uniform for all the gases and corresponds closely with that recorded by other observers. In the case of the Morgantown gas the figure was checked by the use of the delicate iodine pentoxide method.

Hydrogen and Paraffines. Absorption by palladinized asbestos was the method used for hydrogen, the working qualities of the apparatus being checked by use of gas containing hydrogen. On but three of the samples could any contraction whatever be observed. Qualitative tests of the Morgantown gas, using dry palladium chloride, showed but very minute traces of hydrogen. While Phillips records the amount as a trace, others claim one to two per cent. An analysis of the Akron, Ohio, supply (W. Va. gas), by Prof. Knight of Buchtel College, made last summer, shows 1.3% hydrogen. This amount, however, was obtained by calculation based on the explosion data, the hydrogen being considered equivalent to 2-3 [contraction on burning less twice CO_2 formed]. But in every one of the tests made by myself the total contraction after combustion of methane was less than twice the CO_2 formed. In most analyses of natural gas the paraffines have been lumped together as "methane." One vol. of CH_4 burns with two volumes of oxygen to form one volume of CO_2. The vol. taken for combustion includes not only methane but the nitrogen as well. In every one of perhaps fifty analyses, using two methods, two forms of apparatus, and both air and pure oxygen, the resulting vol. of CO_2 was invariably *greater* than the combined vol. of nitrogen and methane taken for the combustion, thus plainly indicating the presence of hydrocarbon molecules con-

taining *more* than one carbon atom and consequently yielding more than one vol. of CO_2 on combustion. As extraction with alcohol failed to show any measurable quantities of propane or butane, the paraffines were assumed to consist of methane and ethane only, and their relative proportions calculated from the combustion data.

Nitrogen. This element is usually estimated "by difference." In the present cases such was impossible, direct examination being necessary, and pure oxygen being therefore demanded for the combustion in place of air. Phillips records several analyses showing 9% nitrogen, though other analysts find less. As my determinations were made by direct reading of the residual nitrogen volume, and as the working error is invariably in favor of high results, the true values for this constituent certainly cannot exceed the figures indicated.

Heavy hydrocarbons. These constituents are largely, though not wholly, responsible for the odor. They include olefines (ethylene,) traces of acetylene, and also traces of higher paraffines, with minute quantities of certain more complex hydrocarbons, the nature of which was not determined. Benzene was found to be absent. Contrary to expectations no measurable quantities of higher paraffines (propane, butane, pentane) could be isolated. These three bodies are very soluble in absolute alcohol, much more so than methane or ethane, yet, though much time was given to this question, repeated shaking with absolute alcohol previously saturated for CH_4 and C_2H_6 failed to give any measurable contraction in the case of any of the gases. Knight has made the same observation. The quantity of higher paraffines present must therefore be less than 0.1%.

Sulphuretted hydrogen. Entirely absent in all the samples. The Morgantown gas, passed through a solution of lead acetate for several hours, failed to give the slightest indication of this body. Use of alcoholic solution of mercuric chloride afforded indications of traces of organic sulphur compounds (mercaptans and thio ethers.) No trace of carbon bisulphide was detectable.

Ammonia. On conducting the Morgantown gas into am-

monia free water containing Nessler reagent, *the entire absence of ammonia or ammonia compounds was demonstrated.*

C. D. HOWARD."

ANALYSES OF NATURAL GAS.

Made during June, 1904, by C. D. Howard. (Percentage by vol.)

	Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.	Sample No. 5.	Sample No. 6.
Carbon dioxide (CO_2)	0.006*	0.1	0.0	0.0	0.1	0.0
Carbon monoxide (CO)	0.4	0.4	0.4	0.4	0.4	0.5
Oxygen (O)	0.2	0.2	0.2	0.1	0.3	0.3
Hydrogen (H)	traee	0.2	0.0	0.1	0.1	0.0
Heavy hydrocarbons	0.4	0.2	0.4	0.2	0.1	0.2
Ethane (C_2H_6)	14 60	14.09	15.09	14.88	14 35	7.65
Methane (CH_4)	80.94	81.60	79.95	80.85	80.70	86.48
Nitrogen (N)	3.46	3.21	3 96	3.47	3.95	4.87
Ammonia (NH_3)	none	none	none	none	none	none
Carbon bisulphide (CS_2)	none	none	none	none	none	none
Sulphuretted hyd'g'n (H_2S)	none	none	none	none	none	n one
Moisture (grains in 100 cu. ft)	17.72					
Total Sulphur (gr. 100 cu. ft)	0.182					
Total paraffines	95.54	95.69	95.04	95.73	95.05	94.13
†BUTl.it. ue]per cu. ft. (cad)	1142.6	1136.9	1140.9	1143.6	1131.4	1065.3

Sample No. 1—Morgantown supply (Big Injun Sand), Monongalia and Greene (Pa.) Cos.

Sample No. 2—Fairmont supply (Bayard Sand) Marion county.

Sample No. 3—Big Injun Sand gas from Lucas Brothers well No. 1, one mile and a fourth northwest of Shinnston. Top of sand 1421 feet below Pittsburg Coal.

Sample No. 4—Gordon Sand gas (Shinnston supply) from J. B. Cunningham well No. 1, three and one half miles northwest of Shinnston, Harrison county. Top of Sand 2199 feet below Pittsburg Coal.

Sample No. 5—Fifth Sand gas from Harbert well No. 1, near West Fork river, and three-fourths mile due east of Lumberport, Harrison county. Top of Sand 2380 feet below the Pittsburg Coal.

Sample No. 6—"Fifty-Foot" Sand gas from Lucas Brothers well No. 4, one mile west of Shinnston, near mouth of Robinson run, Harrison county. Top of Sand 1855 feet below the Pittsburg Coal.

The last four samples of gas were kindly furnished the Survey for analysis as well as the records of the wells themselves by the owner, The Fairmont & Grafton Gas Company.

For purposes of comparison with the results from other gas

*Determined by Barium hydrate.

†Prof. Jones reports B. T. U. slightly over 1100 by Junker calorimeter. Natural gas is taken as a standard (1000) assuming 94%

horizons, and analyses by other chemists, the following tables and statements are quoted from a recent publication by Prof. G. P. Grimsley, of Washburn College, Topeka, Kansas, (and after August 1st, 1904, Assistant Geologist, West Virginia Geological Survey) on "Oil, Gas, and Glass," in Kansas, page 11, as follows:

Chemistry of Kansas Natural Gas.

"The following analyses were made by Prof. E. H. S. Bailey, and published in the University Survey reports a few years ago. They show the gas to be of high grade:"

	Osawatomie.	Coffeyville.	Iola.	Cherryvale.	Independence.	Paola.
Marsh-gas (CH_4)	97.63	96.41	89.66	92.46	95.28	95.20
Carbon dioxide (CO_2)	0.22	0.00	0.90	0.22	0.44	0.33
Ethylene series (C_2H_4)	0.22	0.35	0.00	0.00	0.67	0.11
Carbon Monoxide (CO)	1.33	0.91	1.23	1.16	0.33	1.57
Nitrogen (N)	0.60	2.21	7.76	5.94	3.28	2.34
Oxygen (O)	trace	0.12	0.45	0.22	trace	0.45
Hydrogen (H)	0.00	0.00	0.00	0.00	0.00	0.00

"The following analyses are from the work of Professor Howard, of the Ohio survey:"

	Findlay, Ohio.	Marion, Ind.
Marsh-gas	92 61	93.58
Carbon dioxide	0.26	0.30
Carbon monoxide	0 50	0.60
Nitrogen	3.65	3 45
Oxygen	0.34	0.55
Hydrogen	2.18	1.20
Sulphuretted hydrogen	0.20	0.20

The high fuel value of West Virginia Natural Gas is evident from this comparison, as well as from the results given in the elaborate paper by Prof. Phillips.

PART II

ELEVATIONS ABOVE TIDE

CHAPTER VI.

PRECISE LEVELS.

The Topographic branch of the U. S. G. Survey, in connection with, and aided by the U. S. Coast and Geodetic Survey, is eovering the entire United States with a net work of precise elevations. As a result of this precise leveling, many of the old levels and bench marks accepted for many years as accurate by the railroad officials, civil engineers, and others, have been proven erroneous, often to the extent of several feet. In this readjustment of elevations, the U. S. G. Survey finds it neeessary to change slightly, as a higher degree of accuracy is attained, some of its own former standard elevations, and thus those given of the same bench mark for one year may differ slightly from that given in a later publication. The railroad, civil, and mining engineers are now almost universally adjusting their levels to those given by the U. S. G. Survey, especially sinee the recent plan has been adopted of placing bronze tablets marked with the elevations, in conspicuous positions every few miles in each quadrangle surveyed.

The following lists of levels corrected up to the final adjustments of 1903, have been transmitted to the Survey by Mr. H. M.

Wilson, Geographer, U. S. G. Survey, and prepared and authenticated by S. S. Gannett, of the Computing Division:

Descriptions and Elevations of Permanent Bench Marks of the Coast and Geodetic Survey Along the Baltimore and Ohio Railroad Between Grafton and Parkersburg, W. Va.

(The bottom surface of the square cut is always taken as the bench mark.)

	Feet.
M . Grafton, W. Va.—Cut on top of the north side of the central pier of the Baltimore & Ohio Bridge over Tygarts Valley River, a branch of the Monongahela River. It is marked with the letters "B M" with rectangular figure between	996.856
No. XXXI. About 5.5 miles west of Grafton. Cut on corner stone of the east end of a trestle which is numbered 2 ½ (B. & O. R. R., Parkersburg branch). It is marked with the letters "B M", with rectangular figure between	1082.623
No. XXXII. Cut on corner stone of the west abutment of the Baltimore & Ohio Railroad bridge east of Bridgeport, Harrison county. It is marked with the letters "B M", with rectangular figure between........................	979.628
No. XXXIII. About 2 miles east of West Union, Doddridge county. Cut on top of the pier at the west end of Baltimore & Ohio Railroad bridge No. 21, over Middle Island Creek. It is marked with the letters "B M ", with rectangular figure between..............................	800.186
N. About one-fourth mile east of West Union, and is cut on the top of the southwest corner of the pier of the Baltimore & Ohio Railroad bridge No. 23, over Middle Island creek. It is marked with the letters "B M", with rectangular figure between................................	804.861
No. XXXIV. Cut on the southeast corner stone of the pier of bridge No. 26 (B. & O. R. R.), about ten miles west of West Union. It is marked with the letters "B M", with rectangular figure between..........................	802.817
No.XXXV. Cut on the coping stone of the eastern abutment of the Baltimore & Ohio Railroad bridge No. 31, over Bonds creek, about ¼ mile east of Cornwall station. It is marked with the letters "B M", with rectangular figure between	693.866
No. XXXVI. Cut on the eastern abutment of the Baltimore & Ohio Railroad bridge No. 35, over Bonds Creek, 1 mile east of Cairo, Ritchie county. It is marked with the letters "B M", with rectangular figure between...........	685.954
No. XXXVII.—Cut on the west abutment of the Baltimore & Ohio Railroad bridge over Goose Creek, about 200 meters	

west of Petroleum. It is marked with the letters "B M", with rectangular figure between.........................696.933

No. XXXVIII.—Cut on the northeast cornerstone of abutment of Baltimore & Ohio Railroad bridge No. 44, about 1 mile west of Petroleum. It is marked with the letters "B M", with rectangular figure between............... 693.171

No. XXXIX.—Square cut on the foundation at northwest corner of Baltimore & Ohio Railroad bridge No. 52, 2 miles east of Parkersburg. It is marked with the letters "B M", with rectangular figure between....................... 607.454

O.—At Parkersburg.—Cut on the water table, south front, near western corner of the post office and court house. It is marked with the letters "B M", with rectangular figure between........................ .... 615.806

MONONGALIA COUNTY.

Morgantown, Blacksville and Fairmont Quadrangles.

The elevations in the following list are the partial result of a line of precise levels run from Grafton, West Virginia, over the Baltimore and Ohio Railroad to Leigh; thence over the Pennsylvania railroad to Pittsburg. They are based on the U. S. Coast and Geodetic Survey bench mark "M," at Grafton, a chisel mark on the coping stone at the north end of central pier of railroad bridge over Tygarts Valley River, the elevation of which is now accepted as 996.856 feet above mean sea level. This line forms an element in the precise level net, the result of the 1903 adjustment of which was to lower the elevations at Pittsburg by the continuous unadjusted line 0.112 foot with respect to Grafton. This amount has been distributed between Braddock and Grafton proportional to the distance, a distance of over 142.5 miles.

Between Pittsburg and Braddock no error was distributed, because of a satisfactory check by Pennsylvania railroad levels and to simplify the adjustment.

The leveling was done by Mr. E. L. McNair, assisted by Messrs. J. E. Buford and John W. Hodges, rodmen.

All bench marks set in the course of this work were marked with the word "PITTSBURG" and the date of "1899", in addition to the figures of elevation, thus referring them to the central datum tablet accepted for this group of leveling, which is set in the foundation of the Seventh Avenue Hotel in Pittsburg, the

elevation of which is now accepted as being 738.383 feet above mean sea level at Sandy Hook.

Grafton via Fairmont to Morgantown.	Feet.
Grafton Baltimore & Ohio Railroad bridge across Tygarts Valley River, at north end central pier, coping stone, chisel mark, (U. S. Coast Survey bench mark "M"....	996.856
Grafton, in front of Baltimore & Ohio station; main line, top of rail..	1000.5
Valley Falls, 2.9 miles east of; bridge seat at northeast corner of girder bridge No. 104, 7 feet east of center of track, 4 feet below top of outer rail of curve, bronze tablet marked "986 PITTSBURG 1899".................	985.601
Bush, in front of flag station; top of south rail.............	985.2
Valley Falls, in front of station; top of north rail.......	974.9
Powell's, in front of flag station; top of south rail........	907.6
Powell's flag station, 0.67 mile west of; stone arch bridge No. 108, coping of stone wall, 1.1 feet below top of rail, 7 feet north of center of track, aluminum tablet, marked "899 PITTSBURG 1899"............................	899.043
Colfax, in front of station; top of south rail.............	891.9
Benton Ferry, at signboard, top of south rail..............	889.9
Benton Ferry, 160 feet south of signboard, bridge seat at southwest corner of small girder bridge No. 111, 4.5 feet below top of rail and 18.5 feet south of center of track, bronze tablet marked "885 PITTSBURG 1899"........	885.094
Fairmont, in front of Baltimore & Ohio station, top of east rail..	883.6
Fairmont, 1.25 miles north of Baltimore & Ohio Railroad bridge No. 371, across Monongahela river at north end of east abutment, coping stone, bronze tablet, marked "885 PITTSBURG 1899"......	885.034
Hoult, in front of station; top of west rail.............	882.4
Riverside, in front of flag station; top of east rail......	881.3
Montana, in front of station; top of east rail.............	875.4
Catawba, .8 mile south of; Baltimore & Ohio Railroad one-span bridge (truss) No. 369, coping stone at north end of east abutment 3 feet below rail and 8 feet north of, bronze tablet marked "873 PITTSBURG 1899"..............	872.605
Catawba, in front of station; top of north rail...........	873.0
Luther, in front of station; top of east rail................	867.9
Murray, in front of station; top of north rail.............	868.0
Opekiska, in front of station top of north rail............	866.2
Beechwood, in front of station; top of south rail..........	860.2
Little Falls, 1.33 miles northwest of; face of rock bluff, 9.5 feet west of west rail and 4 feet above same, .5 mile north of bridge No. 366, bronze tablet marked "859 PITTSBURG 1899"................................	858.844

Little Falls, in front of station; top of north rail........ 847.3
Uffington, in front of station; top of north rail............ 831.3
Uffington, 400 feet north of station; coping stone of abutment at northwest corner of one-span truss bridge No. 364, 3 feet below top of rail and 7 feet north of, alumium tablet marked "828 PITTSBURG 1899"............. 827.883
Russell Siding, east rail at.............................. 822.6
Morgantown, 480 feet south of Baltimore & Ohio station; coping stone of abutment at northwest corner of truss bridge over Deckers Creek, bronze tablet marked "821 PITTSBURG 1899"................................ 820.870

Morgantown, West Virginia, to Uniontown, Pennsylvania.

Morgantown, in front of Baltimore & Ohio station; top of east rail.. 823.1
Randall, in front of flag station; top of east rail.......... 824.5
Vanvoorhis, 1 mile south of; bridge seat at southeast corner of steel girder bridge No. 359, bronze tablet marked "815 PITTSBURG 1899"................................ 815.218
Vanvoorhis, in front of station; top of west rail.......... 818.0
Hoard, in front of flag station; top of east rail........... 817.0
State-line post (West Virginia-Pennsylvania), top of, east of rail.. 815.3

PRESTON, MONONGALIA, MARION AND WETZEL COUNTIES.

Bruceton Mills, Morgantown, Blacksville and Mannington Quadrangles.

The elevations in the following list are based upon U. S. Coast and Geodetic bench mark "M" at Grafton, W. Va., a chiseled square on the top of the north side of the central pier of the Baltimore and Ohio Railroad bridge over Tygarts Valley Creek. The elevation of this as determined by that bureau by the 1903 adjustment of precise leveling is accepted as 996.856 feet above mean sea level. The initial points upon which these levels depend are bench marks of the Geological Survey precise level line of 1900 between Grafton, W. Va., and Pittsburg, Pa., the elevations accepted for which are derived also from the 1903 adjustment.

The leveling on the Morgantown quadrangle was done in 1899 under the direction of Mr. Frank Sutton, topographer, by Mr. Wm. Crennell, levelman, that on the Bruceton Mills quadrangle was done in 1901 under the direction of Mr. A. H. Bumstead, topographer, by Mr. M. P. Page, levelman, and that on the

Mannington quadrangle was done in 1902 under the direction of Mr. W. N. Brown, topographer, by Mr. John W. Hodges, levelman.

All permanent bench marks dependent on this datum are marked with the letters "GRAFTON" in addition to the figures of elevation.

The permanent bench marks on the Morgantown quadrangle are referred to the Pittsburg datum and marked with the letters "PITTSBURG" in addition to the figures of elevation.

Morgantown Southeast via Dellslow to Masontown, Returning Westerly and North via Cold Spring, to Morgantown.

(The closure of this circuit slightly exceeded allowable limit.)

	Feet.
Morgantown, 0.4 mile east of; first bridge over Decker's creek on southeast corner of east abutment, chisel mark.......	820.55
Morgantown, .9 mile east of; second bridge over Decker's Creek on northwest corner of east abutment, chisel mark.	823.30
Morgantown, 3.9 miles east of; at Johnson's Mills; third bridge over Decker's Creek, at northeast corner of west abutment of, on bridge seat, chisel mark..............	890.14
Dellslow, north side of creek, 30 feet east of bridge, over, in top of large boulder, aluminum tablet marked "994 PITTSBURG 1899"..................................	993.846
Dellslow, 4.8 miles south of;covered bridge over Decker's Creek, on south side of east abutment, chisel mark.......	1454.81
Masontown, Methodist church, in southeast corner of foundation, aluminum tablet marked "1843" PITTSBURG"..	1842.421
Cold Spring, .5 mile north of; near watering trough west of pike, on large sandstone, aluminum tablet marked "2113 PITTSBURG"................................	2112.571

Masontown, W. Va., Southeast Along Highway to Albright, thence Northeast to Lenox, thence Northerly via Bruceton Mills to Elliottsville, Pa.

	Feet.
Herring Postoffice, southwest corner of stone foundation of church at, bronze tablet marked "2042 GRAFTON"..	2042.080
Herring, 4.3 miles southeast of; 8.4 miles east of Masontown stone abutment over bridge, square cut on........	1767.00
Albright, iron bridge over Cheat river at; northwest corner of stone abutment, square cut on.....................	1214.82
Lenox post office, at southwest corner of stone foundation of, aluminum tablet marked "2123 GRAFTON"........	2122.318
Lenox, 2.25 miles north of; southwest corner of stone foundation of Methodist church, bronze tablet marked "1851	

GRAFTON'.............. .... 1850.258
Bruceton Mills, 1.6 miles south of; residence of Marshall A. Wolfe, southeast corner of cut stone foundation, bronze tablet marked "1578 GRAFTON".................... 1577.470
Bruceton Mills, Lutheran church, northeast corner of stone foundation, aluminum tablet marked "1549 GRAFTON".. 1549.206
Brandonville, 1.5 miles east of; residence of Wm. M. Willott southwest corner of cut stone foundation, bronze tablet marked "1831 GRAFTON"......................... 1831.723

Morgantown Northwesterly to Blacksville.

Feet.

Cassville, 20 feet north of road and 20 feet west of road running north, stone door step of post office, bronze tablet marked "999 GRAFTON"...................... 999.202
Core, 2.2 miles northwest of; 10 feet south of road, bridge over east side of Doll's run, southeast abutment of, bronze tablet marked "913 GRAFTON" 913.265
Worley, 2 miles west of; east side of road, north side of Dunkard creek, bridge over at forks of road, on abutment of, chisel mark...................................... 951.11
Blacksville, (3.9 miles west of Worley), 10 feet east of center of road, bridge over Dunkard creek, 5 feet north of bridge floor, in stone abutment bronze tablet marked "958 GRAFTON"................................... 957.321

Dunkard Creek South Along Highways to Amos, Thence Southeast Along Highway to Catawba.

Feet.

Amos or Fairview, (7.0 miles south of Ponetown) 30 feet from center of road, east side of door to post office, in door step, bronze tablet marked "1000 GRAFTON".... 999.900
Rivesville, 8.3 miles east of Basnettsville, south side of road, iron bridge over Paw Paw Creek, on abutment west side of creek, chisel mark.......................... 859.65

Fairmoint Northwest Along Baltimore and Ohio Railroad via Mannington and Hundred to Bellton.

Feet.

Barrackville, crossing at station, top of rail............ 907.
Barrackville, 3.7 miles northwest of; 1.7 miles southeast of Farmington, bridge No. 116, northeast abutment, on top of, chisel square...................................... 927.51
Farmington, 2.8 miles northwest of; on abutment of bridge chisel square 953:28
Mannington, corner Railroad and Market streets, door of Exchange Bank, pillar north of, bronze tablet marked "975 GRAFTON 1902"............................. 975.056
Metz, road crossing, top of rail........................ 1002.
Glovers Gap, in south foundation of signal tower; bronze

tablet marked "1040 GRAFTON 1902"................ 1039.615
Glovers Gap, in front of station; top of rail.............. 1041.
Hundred, crossing at station; top of rail.................. 1019.
Hundred, 0.1 mile northwest of; northeast abutment of bridge No. 128, on top of bridge seat, bronze tablet marked "1013 GRAFTON 1902"............................ 1013.049
Bellton, in front of station; top of rail.................... 893.

Mannington, North Up Flat Run Along Public Roads via Galletin to Crossroads.

(Single spur line.)

Feet.

Galletin post office, 300 feet east of; north of road, in face of of rock, bronze tablet marked "1452 GRAFTON 1902".. 1452.067
Crossroads, (postoffice), 2.9 miles northeast of; on north of road down Miracle Run, 30 feet east of Mrs. Marberly's dwelling, in face of large rock, bronze tablet marked "1014 GRAFTON 1902"............................ 1014.378

Blacksville, W. Va., West Along Public Roads via Bula, W. Va. Brave, Pa. and St. Cloud, W. Va. to Hundred Station.

Feet.

Bula, 1.7 miles northeast of; northwest abutment of bridge over Dunkard creek, chiseled square..................... 965.44

WETZEL, TYLER DODDRIDGE, HARRISON, PLEASANTS, RITCHIE, GILMER AND BRAXTON COUNTIES.

Littleton, Salem, New Martinsville, West Union, St. Marys, Harrisville, Holbrook and Glenville Quadrangles.

The various initial points upon which these levels depend are bench marks of the Coast and Geodetic Survey transcontinental precise level line and the precise level line of Army Engineers along the Ohio River, the elevations accepted for which being also in accord with the 1903 adjustment.

The leveling here listed was done in 1903, that on the Littleton and West Union quadrangles was done under the direction of Mr. E. I. Ireland, topographer, by Mr. G. L. Gordon, levelman; that on the Salem and part of Holbrook quadrangles was done under the direction of Mr. A. M. Walker, topographer, by Mr. G. L. Gordon, levelman. The remainder of the Holbrook quadrangle being done under the direction of Mr. Albert Pike, topographer, by Mr. F. T. Willis, levelman, and that on the New Martinsville and St. Marys quadrangles was done under the direction of

Mr. W. N. Morrill, topographer, by Mr. R. E. McFadden, levelman.

Permanent bench marks dependent on this datum are marked with the letters "GRAFTON," in addition to the figures of elevation.

Bellton Southwest Along Highways via West to Halls Mills, thence South to Reader, thence Along Highways and Railroad East to Lot, thence Northeast Along Highway to Littleton.

	Feet.
Bannen, 1.1 miles southwest of; schoolhouse, sub dist. No. 9, 8.8 feet southwest of west corner, iron post marked "1398 GRAFTON"	1398.112
Bannen, 2.8 miles southwest of; schoolhouse at forks of road stone steps, bottom step, west end, chiseled square	1376.95
Silverhill, at Laurel Run, bridge over west abutment, south end, chiseled square	1133.96
West, forks of road at; east angle, outcrop of rock, bronze tablet marked "1106 GRAFTON"	1106.218
Halls Mills, 5.3 miles southwest of West; north side of road near Mr. Thomas Adams store and dwelling, outcrop of rock, bronze tablet marked "774 GRAFTON"	774.396
Reader, county bridge over Fishing Creek, south abutment, northeast corner, aluminum tablet marked "693 GRAFTON"	693.676
Reader, 0.8 mile southeast of; B. & O. R. R. bridge No. 145 east abutment, north end, top stone, chiseled square	687.893
Pine Grove, north fork of Fishing Creek, covered bridge over north abutment, southwest corner, chiseled square	712.58
Pine Grove, 1.8 miles southeast of; B. & O. R. R. bridge No. 195 north abutment bridge seat, east end, chiseled square.	723.07
Jacksonburg, at railroad crossing, top of rail	747.3
Jacksonburg, 0.1 mile southeast of; Buffalo Run, B. & O. R. R. bridge over, northwest abutment, south corner of bridge seat, bronze tablet marked "746 GRAFTON"	745.958
Jacksonburg, 6.2 miles northeast of; .05 mile southeast of Lowman's east side of road, outcrop of rock, aluminum tablet marked "839 GRAFTON"	839.184
Lowmans, 5.4 miles northeast of; Uniontown, .08 mile southwest of, south side of road, outcrop of rock, aluminum tablet marked "1133 GRAFTON"	1133.244
Uniontown, 1.0 mile northeast of bridge over Knob Fork Run, northeast abutment, east end chiseled square	1052.65
Uniontown, 4.7 miles northeast of; Small Hollow, bridge over northeast stone of abutment, top of, chiseled square	1179.27

Jacksonburg Southeast Along Baltimore and Ohio Railroad via Smithfield to Brown.

	Feet.
Jacksonburg, 1.3 miles southeast of; railroad bridge No, 236 over Fishing Creek, northwest abutment, northeast end of bridge seat, chiseled square..........................	765.93
Jacksonburg, 3.5 miles southeast of; railroad bridge No. 260 over Fishing Creek, west abutment, north side, top of, chiseled square	803.13
Jacksonburg, 4.75 miles southeast of; northwest corner of Railroad culvert, chiseled square.......................	811.95
Smithfield, 0.2 mile northwest of; Railroad bridge No. 293 over Fishing Creek, north abutment bridge seat, southeast corner, bronze tablet marked "829 GRAFTON"........	828.787
Smithfield, at station, railroad crossing, top of rail........	836.1
Folsom, 1.6 miles northwest of; railroad bridge No. 307 over Fishing Creek, south abutment, second stone from top, chiseled square	870.62
Folsom, railroad crossinig between station and post office top of rail..	952.
Rinehart, 3.6 miles northwest of; 0.2 mile northwest of tunnel station, railroad culvert, southwest corner of chiseled square	1051.61
Rinehart, 0.05 mile southeast of; railroad culvert over Mud Lick Run, northwest corner of, aluminum tablet marked "1059 GRAFTON"................................	1058.895
Rinehart, railroad crossing..............................	1068.4
Wallace, Short Line railroad bridge No. 382, near, southeast abutment, southwest corner, chiseled square.........	1032.26

Leechburg West Along Baltimore and Ohio Railroad to West Union.

	Feet.
Leechburg, 0.5 mile west of; Baltimore & Ohio railroad bridge trestle No. 14, on top of retaining wall, 6th stone from bridge, chiseled square..........................	1039.55
Wolf Summit, 3.8 miles west of; trestle No. 15, B. & O. R. R. on southwest corner of, chiseled square...........	1053.08
Bristol, 0.2 miles west of; top stone of small culvert, northwest corner of, marked "B M"......................	1027.52
Salem, eastmost railroad crossing in, top of rail............	1047.0
Salem, Salem Bank. south face, 4 feet east of corner, in water table, aluminum tablet marked "1047 GRAFTON"	1047.366
Industrial, railroad crossing at, top of rail...............	1074.7
Long Run, 0.7 mile east of; railroad bridge No. 16, east abutment, southwest corner, chiseled square............	877.32
Long Run, railroad crossing at; main track, top of rail.....	854.5
Long Run, 675 feet west of station; north side of Baltimore & Ohio railroad, aluminum tablet marked "853 GRAF-	

TON'' 853.286

Sherwood Post Office, at railroad crossing, top of rail..... 832.0

Morganville, 0.2 mile west of, Baltimore & Ohio railroad bridge No. 17, east abutment, northwest corner, chiseled square 812.39

Smithburg, railroad crossing at, top of rail.......... 797.5

Smithburg, 0.7 mile west of; Coast and Geodetic Survey bench mark ''XXXIII'', on abutment of bridge about 2 miles east of West Union.......... 800.186

Smithburg, 2.1 miles west of; 60 feet west of junction of road from right, bridge over Rock Run, east abutment, southeast corner, chiseled square.......... 778.79

Smithburg, 3 miles west of; Coast and Geodetic Survey bench mark ''N'', on Baltimore & Ohio railroad bridge near West Union.......... 804.862

West Union, Bank Building, stone between door and window of center, center of; aluminum tablet marked ''836 GRAFTON''.......... 836.104

West Union Southeast Along Highway to Wallace.

Feet.

Kenton, 1.1 miles north of; east side of road on bank of Little Flint Run, opposite Junction of West Run, low flat rock, northwest corner, chiseled square.......... 763.97

Kenton, 3.4 miles north of; 0.1 mile west of Eagle Mills post office, in bend at side of road, near dwelling, large flat rock, bronze tablet marked ''760 GRAFTON''...... 759.844

Center Point, 0.1 mile south of; Sharp bend to left in road, northeast side of road, outcrop of rock, bronze tablet, tablet, marked ''790 GRAFTON''.......... 789.746

Center Point, 3 miles east of; and about 160 feet east of J. T. Shield's store, north side of road, rock, top of, chiseled square.......... 864.89

Center Point, 6 miles east of; junction of road at right at Summit (on county line,) southwest angle large rock, chisel square.......... 1277.52

Proctor Southeast Along Highways to Halls Mills.

Feet.

Baltimore & Ohio railroad bridge No. 317 over Proctor Creek, in west end of south abutment, bronze tablet marked ''632 GRAFTON 1903''.......... 632.114

Marion post office, 0.2 mile east of; opposite Marion Moore's store building, south of creek, on stone, chiseled square.... 881.62

Bebee post office, stone steps leading to Lewis Feias house, bottom step, chiseled square.......... 1259.75

New Martinsville Southwest Along East Side of Ohio River to Sistersville, thence Southeast to Middlebourne.

Feet.

New Martinsville, in county court house, facing Main street,

near main entrance, bronze tablet marked "630 GRAFTON 1903"	630.282
Lively crossing flag station, top of rail	630.
Mandota flag station, top of rail	628.1
Paden station, in front of, top of rail	630.
Stewarts crossing, in front of station; top of rail	633.
Sistersville, City Hall and post office building, south side in sill, bronze tablet marked "699 STBNVL"	632.114
Iron bridge over Parsley Creek, at foot of hill, top stone of southeast foundation, T. P.——circle——	736.97
Luzon post office, 0.5 mile southeast of; east side of road, opposite Kellar's old store building, square on stone	1055.41
Luzon post office, 2.5 miles southeast of; northeast abutment of iron bridge over Point Pleasant Creek, near where it empties into Middle Island Creek, on top stone, chiseled square	684.56
Middlebourne, northeast corner of Sheriff's residence, in stone over cellar window, north of front entrance to house, aluminum tablet marked "744 GRAFTON 1903"	745.162

Middlebourne Northeast Along Highway to Reader, thence Northwest Along Baltimore and Ohio Railroad (Short, Line) to New Martinsville.

	Feet.
Polard post office, 0.5 mile northeast of; on rock north of road near Elk Creek, square on	745.46
Conaway post office, in southeast corner of James W. Mayfield's cellar, facing post office, aluminum tablet marked "840 GRAFTON 1903"	841.033
Reader, 2 miles northwest of; southwest abutment of large railway bridge No. 121, over Fishing Creek, chiseled square on	680.73
Flanagan flag station, in front of; top of rail	678.
Reader, 3 miles northwest of; on southwest abutment of bridge No. 110 over Fishing Creek, chiseled square	676.
Porters Falls, 0.6 mile northwest of; on southeast abutment of small bridge, chiseled square	670.64
Minnie flag station, in front of; top of rail	647.2
Minnie flag station; 360 feet west of; on southwest abutment of railway bridge No. 74, chiseled square	646.28
Bard, telegraph office, top of rail	641.2
Minnie, 6 miles northwest of; on north end of small railway culvert, over Bank Run, chiseled square	621.24

Galmish Southwest Along Highway to Lima, thence West to Blue.

	Feet.
Galmish, (pump station), 0.2 mile east of; Baltimore & Ohio railroad bridge No. 159 over Piney Creek, on south end of west abutment, 6th step from top, chiseled square	687.97
Piney, cliff between forks of creek, near the corner, bronze	

tablet marked "790 GRAFTON"	790.039
Lima, 0.37 mile west of; north side of road, outcrop of rock bronze tablet marked "769 GRAFTON"	769.235
Blue, 0.2 mile east of; dwelling, stone steps in front of, second from bottom, east end, chiseled square	734.23

Middlebourne Southeast Along Highway to West Union.

	Feet.
Middlebourne, 0.2 mile southwest of; iron bridge over Garren's Run, east abutment, southwest corner, chiseled square	681.48
Blue, 0.3 mile southeast of; iron bridge over Indian Creek at mouth, northwest abutment, south corner, bronze tablet, marked "707 GRAFTON"	707.193
Blue, 1.6 miles southeast of; McElroy Creek, iron bridge over, northwest abutment, south corner, chiseled square	716.66
Wilbur, 0.15 mile northwest of; 6.5 miles southeast of Blue, east side of road, outcrop of rock, bronze tablet marked "973 GRAFTON"	974.012

Blue Southeast Along Highway to Baltimore and Ohio Railroad Near Toll Gate.

	Feet.
Alma, 3 miles south of; forks of road, southwest angle, corner of store, top of large rock under, chiseled square	717.25
Alma, 6.5 miles southwest of; 0.34 mile south of Bearsville, northeast side of road, northwest side of hollow, outcrop of rock, bronze tablet marked "839 GRAFTON"	839.349
Molehill, Brush Run at north bank of; at forks of road, outcrop of rock, bronze tablet, marked "854 GRAFTON".	854.575
Molehill, 7.5 miles south of; iron bridge on old northwestern pike over north fork of Hughes River, on northeast bridge seat of	793.93
Molehill, 8.3 miles south of; and 0.4 mile west of Toll Gate, U. S. Coast and Geodetic Survey bench mark " " described as follows: Cut on the southeast corner stone of pier of bridge No. 26, (B. & O. R. R.), about 10 miles west of West Union, B. M.	802.817
Greenwood, 0.4 miles west of; on north side of B. & O. R. R. near center of rock cut, bronze tablet marked "854 GRAFTON"	854.635

Toll Gate West Along Baltimore and Ohio Railroad and Highway to Cairo.

	Feet.
Pennsboro, railroad crossing, top of rail	861.
Pennsboro, Farmers and Merchants Bank Building, east face, 2.8 feet north of; southwest corner, 2 feet above pavement, bronze tablet marked "852 GRAFTON"	852.619
Ellenboro, 4.2 miles east of; about ½ way between tunnels	

No. 8 and 9 on ledge of rock south of track, chiseled square........ 872.74
Ellenboro, 1.8 miles east of; on south end of east abutment of Baltimore & Ohio Railroad bridge No. 27, chiseled square.. 807.70
Ellenboro, road crossing at station, top of rail.............. 784.
Ellenboro, 150 feet west of station; in east abutment, south end of Baltimore & Ohio Railroad bridge over small stream from north, bronze tablet marked "780 GRAFTON 1903"........ 780.135
B. & O. Railroad tunnel No. 10, 1 mile east of; on top stone, south end, east abutment of railway bridge No. 28, chiseled square........ 760.672
Railway bridge No. 30, on top stone southwest abutment, chiseled square........ 739.342
Baltimore & Ohio Railroad tunnel, No. 11, west end south side of track, on corner of foundation stone, chiseled square........ 709.21
Cornwallis, in front of station; top of rail................. 686.7
J. P. Cornwallis, 375 feet west of; on north end of east abutment of railway bridge No. 32, chiseled square........ 684.57
Cornwallis, 375 feet west of; in bridge seat of bridge No. 32, north end of east abutment, bronze tablet marked "681 GRAFTON 1903"........ 681.438
Cairo, 1 mile east of; U. S. Coast and Geodetic Survey bench mark "XXXVI", on south end of each abutment of railway bridge No. 35, over Bonds Creek................ 685.954
Cairo, in front of freight station; top of low rail.......... 680.
Cairo, in railway bridge No. 36, north end of east abutment, bronze tablet marked "674 GRAFTON 1903"........... 674.132

Middlebourne Along Highway Southwest to Sugar Valley, thence South to Tunnel No. 11, Baltimore and Ohio Railroad West of Ellenboro.

Feet.

Little post office, on top of east pier south side of large iron bridge over Middle Island Creek, bronze tablet marked "672 GRAFTON 1903"........ 672.187
Wasp, north of; about ½ way between Beech church and Wasp school house, on rock, west side of road, chiseled square........ 722.38
Arvilla post office, on south end east abutment of iron bridge over Middle Island Creek, chiseled square 634.49
Sugar Valley post office, 200 feet west of; on north end of center pier of iron bridge over Sugar Creek, chiseled square........ 617.146
Union Mills, 2 miles north of; 0.4 mile southeast of mouth of McKim Creek, on top of north end of east abutment of iron bridge over creek, 100 feet north of Charles Little's

blacksmith shop, bronze tablet marked "614 GRAFTON 1903" 614.877

Crisp post office, 0.4 mile south of; at road intersection from southeast, on rock near creek, east side of road, chiseled square 655.5

Adlai post office, 75 feet south of J. H. Fleming's house, 135 feet east of road, in rock, bronze tablet marked "777 GRAFTON 1903" 777.320

Pike post office, 300 feet west of south side of road opposite first telephone pole on north side of road, on stone, chiseled square 794.35

West Union South Along Highway via Oxford, Grove and Troy to Leading Creek.

Feet.

West Union, 0.9 mile west of; B. & O. R. R. bridge over pike retaining wall of, 5th step from top, chiseled square.... 844.34

West Union, 5.5 miles southwest of; large dwelling left side of road, near, outcrop, of rock, bronze tablet marked "881 GRAFTON" 881.534

Oxford, 0.25 mile south of; iron bridge over right fork of Hughes River, in south east corner of east pier, bronze tablet marked "814 GRAFTON" 814.678

Grove, in northwest corner of cut stone foundation of residence of C. A. Van Horn, bronze tablet marked "918 GRAFTON" 917.822

Coning's post office, store owned by H. W. Ryner, southeast corner of cut stone foundation, bronze tablet marked "789 GRAFTON" 788.760

Troy, 0.25 mile west of; mouth of Cove Creek, iron bridge over northeast abutment of, bronze tablet marked "758 GRAFTON" 758.953

Pennsboro South Along P. and H. R. R. and Highways via Goose Neck to Hazel Greene, thence Southeast to Troy.

Feet.

Goose Neck, at road crossing, top of rail 741.2

Goose Neck 0.1 mile southwest of; at south end of foot bridge over Hughes River, rock cliff, bronze tablet marked "732 GRAFTON" 732.860

Pullman, 0.2 mile west of: northeast angle of crossroads, outcrop of rock, bronze tablet marked "843 GRAFTON" 843.726

Slab post office, 0.3 mile northwest of; left side of road, 100 feet north of small run, outcrop of rock, top of, chiseled square 791.825

Hazel Green, near northwest corner of store and post office; in stone foundation, bronze tablet marked "742 GRAFTON" 743.389

Lawford, stone house owned and occupied by Mr. D. G. Law,

in northeast corner of; bronze tablet marked "820 GRAFTON".. 820.637

Newberne, 0.5 mile above, school house by forks of road, in southeast corner of foundation of, bronze tablet marked "896 GRAFTON".. 897.360

Cox's Mills, school house, (Troy dist. No. 6), northeast corner of stone foundation, bronze tablet marked "788 GRAFTON".. 788.748

Sand Fork West Along Highway via Glenville to DeKalb.

Feet.

Truebada post office, northeast side of road at forks to north, on stone, chiseled square........................ 722.78

Iron Bridge over mouth of Stewarts Creek, southeast corner, chiseled square on stone............................ 720.55

Glenville, bridge over Little Kanawha river, in top stone of middle pier on east side of bridge, bronze tablet marked "733 GRAFTON"................................ 732.737

Mouth of Sycamore Creek, on southeast corner of east abutment of bridge at, square 714.93

Iron bridge across Leading Creek near mouth, northwest corner of west abutment, square........................ 722.50

Bridge across mouth of Sinking Creek, northwest corner of stone abutment, chiseled square 710.45

DeKalb, just back of post office; in southwest corner of residence, on second course of masonry foundation, bronze tablet marked "715 GRAFTON"........................ 714.628

Glenville Southeast Along Highway to Cutlips, thence West to Heater.

Feet.

Centerville, 4.2 miles south of; northwest abutment of iron bridge over Cedar Creek, square cut on................ 739.29

Cedarville, 5.3 miles northwest of; on stone at ford over Cedar Creek, chiseled square 745.69

Cedarville, at front of residence now owned and occupied by W. H. Jack, on west side of cut stone steps, in big stone, aluminum tablet marked "802 GRAFTON"............ 801.927

Cedarville, 6 miles southeast of; near house, to left of road, on big stone, chiseled square.......................... 821.90

Hope, about 2.5 miles east of; at forks of road leading up Tom's Run, near hickory tree, on big rock, chisel mark.... 832.79

Cutlip, in southwest corner of cut stone foundation of church, aluminum tablet marked "851 GRAFTON"...... 851.084

Mouth of Tom's Run Along Highway West via Hope to Stumptown, thence North via Normantown to DeKalb.

Feet.

Hope, post office, on the stone foundation of old log stable chiseled square 988.36

German, house occupied by John Seal and owned by C. F.

Gerwig, in southwest corner of stone foundation, aluminum tablet marked "861 GRAFTON" 860.744
German, 6.2 miles north of; at forks of road, school house, on stone foundation at southwest corner, chiseled square . . 867.16
Perkins, to right of road at forks, in large stone, chiseled square 770.56
Perkins, 3.3 miles west of; in southwest corner of stone foundation of school house, at forks of road, aluminum tablet marked "741 GRAFTON" 741.015
Stumptown, 0.5 mile east of; at forks of road iron bridge over left fork of Steer Creek, in southeast corner of east pier, bronze tablet marked "714 GRAFTON" 713.685
Normantown, at forks of road up Steer Creek, on stone, chiseled square 736.18
Letter Gap, south angle of crossroads ,at north corner of dwelling now owned and occupied by A. S. Westfall, in top foundation, stone, northwest face, aluminum tablet marked "827 GRAFTON" 826.782

HANCOCK AND BROOKE COUNTIES.

Wellsville and Steubenville Quadrangles.

The elevations in the following list are based upon an aluminum tablet at the southeast corner of the Jefferson County Court House at Steubenville, Ohio, marked "716 STEUBENVILLE." The elevation of this is accepted as 714.729 feet above mean sea level and was determined from the Army Engineers bench mark "67 A" on the water table of the same building, the elevation of which in accord with the Coast and Geodetic Survey adjustment of 1903 of precise leveling is 710.306 feet.

The initial points upon which this leveling depends include other bench marks of the Army Engineers precise level line along the Ohio River the elevations accepted for which accord with said adjustment.

The leveling on the Wellsville quadrangle was done in 1902 under the direction of Mr. Van H. Manning, topographer, by Mr. A. T. Bagley, levelman.

The leveling on the Steubenville quadrangle was done in 1902 under the direction of Mr. C. F. Cooke, topographer, by Mr. J. E. Buford, levelman.

All permanent bench marks dependent on this datum are marked with the letters "STEUBENVILLE" or "STBNVL" in addition to the figures of elevation.

East Liverpool, O., via Fairview, W. Va., to New Cumberland, W. Va.

	Feet.
Chester, 1 mile south of; 0.25 mile east of Locust Grove Cemetery, Allison triangulation point, bronze tablet in top of marble post marked "1337 STBNVL"	1337.156
Fairview, on the north side of Tri State Normal School, at base of stone frame to front door of; aluminum tablet marked "1196 STBNVL"	1195.636
New Cumberland, (U. S. A. Engineer Corps bench mark "56 A"), D. S. Schiller Foundry Co's Works, southwest corner of, Front and Ferry streets, in west end of door step, chiseled square	670.66

Cross Creek Bridge Northeast to Colliers, thence West to Hollidays Cove.

	Feet.
Cross Creek, 3rd bridge over, opposite Wabash concrete bridge, southeast corner of, in stone abutment, chiseled cross	672.400
Colliers station, at northwest corner of bridge, in stone abutment of, aluminum tablet marked "824 STBNVL"	823.597
Hollidays Cove, 0.5 mile east of; bridge marked "39" Panhandle Railroad, in southeast corner, in coping stone, chiseled cross	741.90

Hollidays Cove Station North to New Cumberland.

	Feet.
Zalia, 100 feet south of church, on each side of road, opposite lower end of Toronto street ferry, in big boulder, bronze tablet marked "704 STBNVL"	703.720

New Cumberland East to Carsons Oil Wells, thence Southwest to Hollidays Cove.

	Feet.
New Cumberland, 3.25 miles east of; at northeast corner of bridge, "T" cut in stone	735.14
Comettsburg, southwest corner of Freshwater's house, bronze tablet marked "1150 STBNVL"	1149.920

School House on Cross Creek via Independence, Pa., to Wellsburg, W. Va.

	Feet.
Colliersville, 5 miles south of; covered bridge, in southwest corner of abutment, cross cut in stone	754.58
Independence, Pa.. 2.5 miles northwest of; bridge over creek, in southeast corner, of, aluminum tablet marked "784 STBNVL"	784.024
Wellsburg, W. Va., 1 mile east of; stone horse block in front of Jacob's house, aluminum tablet marked "1001 STBNVL."	1000.935

BROOKE, OHIO, MARSHALL, PLEASANTS, WOOD, WIRT AND JACKSON COUNTIES.

Wheeling, Cameron, Waverly, Guyandotte, Parkersburg, Milton and Belleville Quadrangles.

The elevations in the following list are based upon Coast and Geodetic Survey bench mark "M" at Grafton, W. Va., a chiseled square on the top of the north side of the central pier of the Baltimore & Ohio Railroad bridge over Tygarts Valley creek. The elevation of this as determined by the bureau by the adjustment of 1903 precise leveling is 996.856 feet above mean sea level.

The initial points upon which these levels depend are various bench marks of the Army Engineers (Ohio River Survey) and Coast and Geodetic Survey (transcontinental) precise level lines of the precise level net.

The leveling on the Wheeling quadrangle was done in 1901 under the direction of Mr. W. C. Hall, topographer, by Mr. W. A, Freret, Jr., levelman; that on the Cameron quadrangle was done in 1902 under the direction of Mr. W. N. Brown, topographer, by Mr. Geo. L. Gordon, levelman; that on the Marietta and Parkersburg quadrangles was done in 1902; and that on the Guyandotte quadrangle in 1901 under the direction of Mr. W. N. Morrill, topographer, by Mr. J. W. Hodges, levelman; and that on the Milton quadrangle was done in 1901 under the direction of Mr. W. N. Brown, topographer, by Mr. J. W. Hodges, levelman; and that on the Belleville quadrangle was done in 1903 under the direction of Mr. W. N. Morrill, topographer, by Mr. John W. Hodges, levelman.

All permanent bench marks dependent on this datum are marked with the letters "GRAFTON" in addition to the figures of elevation.

The bench marks on the Guyandotte and Milton quadrangles were stamped to read about 2 feet too high, due in part to error in the initial line.

Wheeling Along National Pike via Elm Grove to Triadelphia.

Feet.

Wheeling, City Building north front of; 37 feet east of

northwest corner of, (U. S. Engineer Corps bench mark,) No. 90 ''A'', chiseled square........................ 678. 250
Wheeling, 1.1 miles east of post office, Baker street bridge on Wheeling Creek, southeast end of bridge, on southwest corner of coping stone, chisel mark.................. 651.23
Elm Grove, 1 mile southeast of; bridge over Little Wheeling Creek, near its junction with big Wheeling Creek, on top of west coping wall, in third stone from center, cut........ 694.75
Triadelphia, M. E. Church, brick building, southwest corner of, in foundation stone, south face, aluminum tablet marked ''743 GRAFTON''.......................... 744.570

Triadelphia Along Middle Wheeling Creek via Twilight to Valley Grove.

Feet.

Twilight, 1.1 miles northwest of; northeast abutment of bridge over Wagners Run, northeast corner of stone, chisel mark.. 802.03
Twilight, 3.1 miles northeast of; near junction of Haneytown pike and Middle Creek road; bridge over Little Wheeling Creek, northeast wing retaining wall of, corner of fourth stone from top, chisel mark.......................... 949.79
Valley Grove, Baltimore & Ohio railroad bridge No. 174, Pittsburg Division) north face of south pile, bronze tablet marked ''953 GRAFTON''........................... 952.648

Valley Grove Along National Pike and McGraw's Run to Bethany.

Feet.

Bethany, 5.1 miles south of; 6.5 miles north of Valley Grove, southeast abutment wall of wooden bridge over Long Run, on southeast corner of third stone from top, chisel mark.. 1020.87
Bethany, 2 miles south of; northeast corner of M. E. Church, southeast front step, in top stone, chisel mark............ 954.32
Bethany, 0.3 miles west of; Bethany College, front face of building, first entrace west of main entrance, north side of entrance, east face stone, water table, aluminum tablet marked ''932 GRAFTON 1901''..................... 931.774

Bethany Along Pike to Short Creek.

Feet.

Bethany, 2.6 miles west of; west end of bridge over Buffalo Creek, north wing wall, on northeast corner of; top stone, chisel mark 743.82
Shortcreek, brick store and post office, west face of, 25 feet from southwest corner and two feet above ground, aluminum tablet marked ''668 GRAFTON 1901'' 667.963
Shortcreek, 0.1 mile south of; west side of railroad track, Pittsburg, Cincinnati, Chicago & St. Louis railroad bridge No. 12, over Shortcreek (Division Line between Brooke and Ohio counties, W. Va.), south abutment of,

chiseled square on top of marked "B M", U. S. Engineers bench mark No. 81 A.................................. 652.724

Moundsville East Along Public Roads via Limestone and Beula Station to Rocklick.

Feet.

Moundsville, (U. S. Engineer's bench mark 101 B) Marshall county courthouse; in front of building, 17.2 feet east of center of doorway, on top of water table of foundation of 690.510

Limestone, dwelling of R. H. Peters, (only brick building in Limestone), front of foundation, top stone, 2.7 feet northwest of center of door, bronze tablet marked "1377 GRAFTON" 1376.762

Pleasant Valley, 0.4 mile southeast of; brick dwellinig, (J. W. Cunninigham's), stone at front gate, top of, chiseled square 1317.03

Beeler Station, first step above stone platform, northeast corner, chiseled square 1356.52

Rocklick South Along Public Roads and Baltimore and Ohio Railroad via Cameron and Woodruff to Bellton.

Feet.

Rocklick, 0.3 mile south of; south side of south east corner of schoolhouse, second stone, aluminum tablet marked "1464 GRAFTON" 1463.755

Cameron, 1.8 miles northeast of; M. E. Church at northeast angle of crossroads, at south end of retaining wall, top of, chiseled square.................................. 1074.74

Cameron, west end of brick public school building, water table 0.9 foot north of southwest corner, bronze tablet marked "1170 GRAFTON"............................ 1169.808

Woodruff, 0.7 mile northwest of; west end of stone culvert, center of top of, chiseled square...................... 1015.82

Bellton, 0.1 mile north of; railroad bridge No. 136, north abutment, southeast corner, 2.7 feet above bridge seat, bronze tablet marked "888 GRAFTON".............. 887.505

Bellton West Along Public Roads via Adaline to Lynn Camp.

Feet.

Kausooth post office, 2.4 miles west of; bridge over Big Run, top of west abutment, 12.5 feet right of center of bridge, chiseled square.................................... 768.32

Lynn Camp North Along Public Roads and Baltimore and Ohio Railroad via Meighen and Rosbysrock to Moundsville.

Feet.

Meighen, at schoolhouse No. 5, east side, 8 feet from southeast corner, top stone of foundation, bronze tablet marked "691 GRAFTON".................................. 690.564

Rosbysrock, at Big Grave Creek; iron bridge over, northeast

abutment, 12 feet southeast of center of bridge, 1 foot below bridge seat, bronze tablet marked "779 GRAFTON" 778.214

Rosbysrock, 4 miles northwest of; railroad bridge No. 146 over Big Grave Creek, south abutment, top of northwest corner, chiseled square 680.63

Moundsville, Marshall County Court House; south front of, 17.2 feet east of center of doorway, bronze tablet marked "690 GRAFTON" 689.284

Lone Oak School House North Along Public Roads to Hazeldell School House.

(Single spur line.)

Feet.

Hazeldell or Irish Ridge School House, center of southwest corner stone, bronze tablet marked "1322 GRAFTON" .. 1321.513

Parkersburg East Along Highway via Tallyho to Deerwalk, thence Northerly via Borland to Willow.

Feet.

Parkersburg, (U. S. Engineers bench mark No. 183 A) corner of 5th and Julian streets; at southeast corner of U. S. Custom House, on top, of foundation water table, chiseled square 615.806

Parkersburg post office building; on south side of, near west end, in water table, bronze tablet marked "616 GRAFTON 1902" 615.639

Parkersburg, 3.2 miles east of; on south side of pike on south foundation of small bridge, chiseled square 602.43

Tallyho, 1.5 miles southeast of; opposite Shiloh United Brethren Church, at forks of road, in large boulder, aluminum tablet marked "714 GRAFTON 1902" 713.560

Borland post office, 100 feet east of; on south side of Bull Creek, bronze tablet marked "683 GRAFTON 1902". 682.728

Willow West Along South Side of Ohio River to Williamstown and Across to Marietta.

Feet.

Willow Island, station, in northeast corner of foundation wall of Jos. I. Norris dwelling, aluminum tablet marked "615 GRAFTON 1901" 615.448

Compton, in front of station, top of rail .... 615.

Williamstown, South Along East Side of Ohio River to Parkersburg.

Feet.

Williamstown, in front of station; top of rail .... 610.

Polick, in front of station; top of rail .... 616.

Kellar, in front of station; top of rail .... 613.

Briscoe station, opposite public highway to post office, in face of rock ledge facing Ohio River, bronze tablet marked "594 GRAFTON 1902" 593.662

Parkersburg Along Highway South via Newport and Mineral Wells to Rockport.

	Feet.
Mineral Wells, 1.2 miles southwest of; in face of abutment of small iron bridge over Bailey's Creek, northwest end, aluminum tablet marked "593 GRAFTON 1903"........	593.409
Fountain Springs, north abutment of iron bridge over Tygarts Creek, top of, chiseled square	622.34
Saulsbury, 1.2 miles south of; east of road, on northeast end of Valley Belle Scheolhouse, on top of corner stone, chiseled square..........	653.76
Rockport, opposite schoolhouse No. 2, at forks of road, on top of large rock, aluminum tablet marked "700 GRAFTON 1903"...........	700.497

Rockport Along Highway West to Belleville.

	Feet.
Sloan, 0.2 mile west of; on rock north of road, chiseled square	726.89
Oak post office, 0.8 mile west of; on stone of small culvert on north side of road, chiseled square..................	619.74
Belleville, 0.8 mile south of; 0.2 mile south of road crossing, in small ravine east of track, on top of rock, aluminum tablet marked "595 GRAFTON 1903"..................	595.172
Pond Creek, (Army Engineer's bench mark "204 A") 1200 feet north of; capstone of culvert, northwest corner....	599.227

At New England.

(Set from Army Engineers B. M. "195 A".)

	Feet.
New England, Ohio River railway station, 0.5 mile west of; on west abutment of culvert of Ohio River railway, 1200 feet above Mushapha Island, over Beadle's Run, 7 feet north of south end of culvert, 23 feet west of center of railway, and .008 foot higher than adjoining Army Engineer's B. M., aluminum tablet marked "591 GRAFTON 1903"	590.712

Rockport Along Highway South to Wiseburg, thence West via Cuba to Sherman.

	Feet.
Rockport, 1 mile south of; on southwest abutment of small bridge over Tygarts Creek, chiseled square..............	761.58
Wiseburg, 240 feet north of post office, north side of road, on top of rock, aluminum tablet marked "663 GRAFTON 1903"	662.901
Medina post office, 0.7 mile west of; 100 feet west of dwelling, north of road, near small bridge, on rock, chiseled square	676.27

Kenova East via Huntington and Hurricane to Youngs Store.

Feet.

Kenova, Union station; west side of door sill of main waiting room, aluminum tablet marked "567 K".............. 566.918
Kellogg, 1.3 miles east of; south of track on small culvert, chiseled square..... .... 564.59
Central Station; in front of; top of south rail of south track .... 549.
Huntington, in front of station; top of rail of south track 565.
Huntington, southeast corner of 10th street and 2nd Avenue, between Chesapeake and Ohio and Ohio River railroads, brick building occupied in 1899 by Sehon Blake and Stevenson Wholesale Grocery Company, west face of stone foundation, 18.8 feet south of west corner and 1.5 feet below floor, (U. S. Engineers' B. M. No. 307 A)....... 547.463
Huntington Court House, corner of Fourth and Eighth streets, north corner of east entrance to court house, aluminum tablet marked "564 GRAFTON"............... 563.833
Wilson station, 3.1 miles east of; in southeast abutment of railway bridge over Mud river, bronze tablet marked "572 GRAFTON" 569.606
Ona, in W. T. Sanford's dwelling, on north east corner of foundation, third stone from ground, bronze tablet marked "634 GRAFTON" 631.957
Milton, corner of Railroad and Pike streets, in foundation stone of J. S. Kane's vacant store building, southeast corner of street, bronze tablet marked "585 GRAFTON". 583.226
Walton switch, opposite top of rail...................... 623.
Hurricane, 0.1 mile west of station; opposite small highway bridge, on north of track, on top stone of culvert, bronze tablet marked "667 GRAFTON"............... 666.688
Young's store, first house south on south side of road, owned by John Hodges, in east chimney 1 foot from ground, copper bolt marked "737 G"........................... 737.294

Ceredo South Along Norfolk and Western Railway to Wayne.

Feet.

Buffalo station, southwest abutment of bridge over Buffalo Creek, 7 feet from track, aluminum tablet marked "565 GRAFTON" 562.455
Buffalo, in front of station; top of rail.................. 563.
Shoals station, road crossing, top of rail.................. 572.
Lavalette, in front of station; top of west rail............. 565.
Dickson station, opposite mail crane, top of rail............ 581.
Ardell, at station; opposite mail crane, top of rail.......... 588.

Ardell (Herbert Post Office) West Along Road to Lockwood, Ky.

Feet.

Ardell, (Herbert post office), across Twelvepole Creek; opposite M. E. Parsonage, on west side of public highway,

in large boulder, bronze tablet marked "591 GRAFTON". 588.585

Shoals Northeast to Hodges.

	Feet.
Hodges, 125 feet north of road; opposite John Hodges dwelling, on east of road leading to Huntington, on small boulder, aluminum tablet marked "710 GRAFTON".....	708.184

Herbert East Along Road to Sarah, thence North to Wilson Station.

	Feet.
Herbert, 7.5 miles northeast of; up Bottom Branch, 0.5 mile above fork of road leading down Millers' Branch on south of road in boulder, bronze tablet marked "623 GRAFTON".....	620.775
Poppa, west of road nearly opposite post office; on top of large boulder, aluminum tablet marked "612 GRAFTON"..	609.584
Martha post office, northeast abutment of highway bridge over Guyandotte River, in top stone, bronze tablet marked "563 GRAFTON"....................................	561.190
Wilson station, 3.1 miles east of; on southeast abutment of Chesapeake and Ohio Railroad bridge over Mud River, bronze tablet marked "572 GRAFTON"...............	569.606

Ona South via Fudges Creek and Cabell Creek to Guyandotte River at Roach.

(Single spur line.)

	Feet.
Fudges Creek (post office), 5 miles south of Ona; stone chimney of, 2 stones above grade, bronze tablet marked "736 GRAFTON"....................................	733.360

Hurricane South to Nye, thence West via Hamlin to Sarah.

Nye, county bridge over Trace Fork of Mud River; in top stone of northwest pier of; bronze tablet marked "625 GRAFTON".....	623.468
Hamlin, in northeast end of abutment wall of bridge over Mud River, third stone from top, bronze tablet marked "645 GRAFTON"....................................	642.516
Salt Rock, in retaining wall of highway bridge over Guyandotte River; northeast end, third stone from top, bronze tablet marked "586 GRAFTON"....................	586.536

MARION, TAYLOR, HARRISON BARBOUR, UPSHUR, DODDRIDGE, GILMER, BRAXTON, LEWIS AND NICHOLAS COUNTIES.

Fairmont, Philippi, Weston, Clarksburg, Vadis, Burnsville and Flatwoods Quadrangles.

The various initial points upon which these levels depend are bench marks, of the precise level net, established by the Coast

and Geodetic Survey and the Geological Survey, the elevations accepted for which being also in accord with the 1903 adjustment.

The leveling on the Fairmont and Philippi quadrangles was done in 1901 under the direction of Mr. W. C. Hall, topographer, by Mr. Geo. L. Gordon, levelman; that on the Clarksburg and Weston quadrangles was done in 1901 under the direction of Mr. W. N. Morrill, topographer, by Mr. J. H. Hodges, levelman; and that on the Vadis, Burnsville and Flatwoods quadrangles in 1902 under the direction of Mr. A. M. Walker, topographer, by Mr. Geo. L. Gordon, levelman.

All permanent bench marks depending on this datum are marked with the letters "GRAFTON" in addition to the figures of elevation.

Fairmont, via Farmington, Monongah, Boothsville and Meadland, to Bridgeport

	Feet.
Fairmont, 0.32 mile east of; suspension bridge over Monongahela River, north end of, northwest corner of east revetment wall, chiseled square on stone...............	902.51
Fairmont, 2.4 miles west of; wooden bridge over Ice's Run, west wall of, on northeast corner of top stone, chiseled square	986.18
Fairmont, 3.9 miles west of; iron bridge over Buffalo Creek, north abutment wall of, 2 feet east of southwest corner of, chiseled square	918.03
Katy, 1.5 miles west of; George's Creek Coal and Iron Company's Shaft Building, southeast corner of retaining wall, on top stone, chiseled square........................	956.61
Farmington, George's Creek Coal and Iron Company's store, northeast corner of, front face of water table, bronze tablet marked "952 GRAFTON 1901".................	951.710
Farmington, 5.6 miles south of; iron bridge over Monongahela River, northwest pier, southeast corner of top stone, chiseled square................................	892.13
Monongah, Baltimore & Ohio Railroad Plate Girder Bridge over Booths Creek, west face of north pier, 2 feet from southwest corner, in seventh stone from top, bronze tablet marked "874 GRAFTON"......................	873.916
Eldora, 1.5 miles south of; on road from right, iron bridge over Booths Creek, north abutment wall, 0.7 foot from southwest corner, in top stone, chiseled square..........	953.38
Boothsville, covered bridge over Hustead's Fork, west face of north abutment, 3.5 feet from southwest corner and	

4.5 feet from top, bronze tablet marked "954 GRAFTON"	954.130
Boothsville, 3.1 miles south of; wooden bridge over Husteads Fork, in south corner of northeast abutment, chiseled square	1017.67
Boothsville, 7.1 miles south of; 50 feet east of crossroads, bridge over Husteads Fork, west abutment, northeast corner, chiseled square	1310.16
Meadland, brick house owned by L. J. Stark, front or east face of, foundation 1 foot from northeast corner of, bronze tablet marked "1319 GRAFTON"	1318.530
Bridgeport, railroad bridge No. 6 over Simpson's Creek, west abutment of, south end, third stone from top and second above bridge seat, center of east face of, bronze tablet marked "979 GRAFTON"	978.773

Grafton via Webster, Simpson, Flemington, Rosemont, Oral and Bridgeport to Clarksburg.

	Feet.
Grafton, Baltimore & Ohio railroad bridge over Tygarts Valley Creek; on top of north side of central pier (U. S. Coast and Geodetic Survey bench mark), chiseled square	996.856
Webster, Baltimore & Ohio railroad bridge No. 2 over Bartlett's Creek, south abutment wall of, third stone from top, northeast face of, 1.15 feet from east corner, bronze tablet marked "1014 GRAFTON"	1013.770
Webster, (5.5 miles west of Grafton:) trestle No. 2½, on corner stone, chisel mark (Coast Survey bench mark No. XXXI,)	1082.623
Rosemont, road crossing near station; ground	1003.
(Line continued along turnpike to avoid tunnel.)	
Clarksburg, post office, corner Pike and Third streets; northwest corner, 2 feet above ground, aluminum tablet marked "1006 GRAFTON"	1007.699

Monongahela Junction to Monongah.

	Feet.
Glen Falls, in front of station; top of rail	932.0
Meadowbrook, iron railway bridge, northwest corner of abutment marked "B M"	922.97
Gypsy, in front of station; top of rail	915.0
Shinnston, west branch of Monongahela river, highway bridge over, southwest corner of retaining wall, bronze tablet marked "909 GRAFTON 1901"	910.461
Worthington, in front of station; top of rail	896.0
Worthington, southwest abutment of highway bridge, south end of, on top seat, bronze tablet marked "898 GRAFTON 1901"	899.236
Highland, in front of station; top of rail	892.0
Monongah, west branch of Monongahela river, highway	

bridge over, on top of southeast abutment of, chiseled square 892.09

Enterprise, Up Bingamon Creek West and South via Wyatt, Margaret (Henpeck) and Brown to Lynchburg.

	Feet.
Enterprise, 5.4 miles west of; highway covered bridge over Bingamon Creek, on southeast corner of retaining wall, chiseled square	947.36
Margaret, Quaker Fork of Bingamon Creek, covered highway bridge over, in northwest corner of, bronze tablet marked "1032 GRAFTON 1901"..............................	1032.220
Irving, at road crossing near station; (Short line railway) top of rail..	1016.
Browns, 0.2 mile west of; Short Line Railroad bridge over Little Ten-Mile Creek (Trestle 404), southwest abutment of, in top of capstone, bronze tablet marked "999 GRAFTON 1901"..	999.183

Clarksburg, West via Adamston, Wilsonburg, Wolf Summit to Lynchburg.

	Feet.
Adamston, (Baltimore & Ohio Railroad) 0.05 mile west of; northeast corner of trestle No. 9, top stone of, chiseled square	960.68
Wilsonburg, in front of station; top of rail................	984.0
Wilsonburg, 0.5 mile west of; on small culvert south of track, chiseled square..	997.66
Reynoldsville, at road crossing near station...............	1101.0
Wolf Summit, Wm. M. Dolan's store, southeast corner of, in end of stone curbing, bronze tablet marked "1133 GRAFTON 1901"..	1134.512

Bridgeport via Berryburg, Switzer and Pleasant Creek to Webster.

	Feet.
Berryburg, Southern Coal and Transportation Company Tipple, retaining wall of, west of tipple and in front of power house, fourth stone from top, bronze tablet marked "1390 GRAFTON"..................................	1389.50
Switzer, 1.1 miles northeast of; east side of pike, residence of B. H. Woodford, stone gate step, on southeast corner, chiseled square	1447.69
Pleasant Creek, brick residence of A. I. Cole, west corner of stone foundation, fifth stone from top and fourth from ground, 1.45 feet from corner, bronze tablet marked "1170 GRAFTON"	1170.044

Switzer via Philippi to Pecksrun.

	Feet.
Switzer, 4 miles south of; covered bridge over Tygarts Valley River. east abutment wall, northwest corner of top stone, chiseled square..................................	1308.01

(Line continues along Main street.)

Philippi, brick school house, north side of front entrance to, center north face of foundation stone, bronze tablet marked "1311 GRAFTON" 1310.685
Philippi, 10.4 miles south of; (Buckhannon or Tygarts Junction) Tygarts Valley River, Plate Girder Bridge No. 1 over, west abutment of, north side of, first stone above bridge bed, in center of east face, bronze tablet marked "1334 GRAFTON" 1333.540
Volga, 3.2 miles west of Malta, Baltimore & Ohio railroad bridge over Wash Run, north abutment of, east face of, in center of third stone from top, bronze tablet marked "1404 GRAFTON" 1403.859
Volga, 2.5 miles west of; bridge over Pecksrun, north abutment of, west side, northwest corner of, second stone from top, chiseled square 1405.46
Pecksrun, post office, (or Hodgeville) bridge over Pecksrun; south abutment, northwest corner of, on west side of, second stone from corner, chiseled square 1419.27

Pecksrun via Peel Tree and Overfield, to Pepper.

Feet.

Peel Tree, residence of Dr. Isaac Smith; retaining wall in front of, at opening for steps, west face of south wall, third stone above third step from sidewalk, in center of, bronze tablet marked "1069 GRAFTON" 1068.789
Peel Tree, 2.9 miles north of; Dever Pickens' dwelling, stone stile in front of, third step from bottom, chiseled square 1093.66
Peel Tree, 4.4 miles north of; iron bridge over Elk Creek, north abutment, southeast corner of, chiseled square 1023.10
Overfield, 3.1 miles northeast of; Cletus Stout's dwelling, east side of stone stile in front of, on north end of bottom step, chiseled square 1103.11

Pecksrun to Buckhannon.

Feet.

Buckhannon, Upshur county court house, front entrance, west side of, base of block of square column, in center of west face, aluminum tablet marked "1433 GRAFTON" .. 1432.881

Buckhannon to Ruraldale.

Feet.

Ruraldale, 0.6 mile west of; near fork of road by old mill, 200 feet east of residence of V. H. Regar, in face of large rock, bronze tablet marked "1121 GRAFTON 1901" 1122.118

Ruraldale via Johnstown, Quiet Dell, etc. to West Milford.

Feet.

Johnstown, 0.1 mile west of; ledge of rock north of road, in face of, bronze tablet marked "1062 GRAFTON

1901''.......... .... 1062.946

Quiet Dell, 0.5 mile south of; 600 feet from crossroads; large boulder on west of road, aluminum tablet in top marked ''1050 GRAFTON 1901''..................... 1050.778

West Milford, highway bridge over West Fork, southwest corner of, on top of bridge seat, bronze tablet marked ''979 GRAFTON 1901''................................ 979.363

Clarksburg to West Milford.

West Milford South Along Highways to Weston.

(The error distributed in this line is excessive.)

Feet.

Jane Lew, W. Va.. southeast end of railway bridge over Hacker's Creek, first stone below bridge seat, on top of, aluminum tablet marked ''1007 GRAFTON 1901''..... 1006.997

Weston Along Road to Ruraldale.

Feet.

Weston, southwest pier of Baltimore & Ohio railroad bridge over West Fork; first stone below bridge seat, bronze tablet marked ''1017 GRAFTON 1901''................. 1017.740

West Union Along Pike to Point 2.2 Miles Southeast of New Milton.

(Mean of direct and reverse lines.)

Feet.

U. S. Coast and Geodetic Survey bench mark ''N'' Baltimore & Ohio railroad bridge over Middle Island Creek, on top of the southwest corner of pier of, chiseled square...... 804.862

Sugarcamp, 0.5 mile southeast of; iron bridge over Middle Island Creek, southwest corner of east abutment, bronze tablet marked ''830 GRAFTON''...................... 829.950

Point 2.2 Miles Southeast of New Milton Southeast Along Pike via Avon and Churchville to Weston.

Feet.

Avon, 0.2 mile southeast of; covered bridge over Middle Island Creek, north abutment, west end, chiseled square.. 867.34

Churchville, 0.55 mile southeast of; left side of main road to Weston, west side of middle of large rock, aluminum tablet marked ''972 GRAFTON''...................... 971.906

Weston West Along Road via Alumbridge and Linn to Mouth of Fink Creek, thence North via Hurst to New Milton.

Feet.

Camden, opposite post office, in front yard to P. E. Fetty's house, 8.5 feet west of porch and 1 foot south of fence, iron post marked ''1096 GRAFTON''................. 1095.782

Alumbridge, Alum Fork of Leading Creek, at; iron bridge over; southeast corner west abutment, bronze tablet marked ''810 GRAFTON''............................ 810.172

Linn, 1.75 miles northwest of; iron bridge over Fink Creek,

east abutment, northwest corner of bridge seat, bronze tablet marked "766 GRAFTON" 766.091
Hurst, cliff at, facing south; 4.5 feet below top of, bronze tablet marked "815 GRAFTON" 814.958

Avon East via Country Road towards Big Isaac.

Feet.

Avon, 1.8 miles southeast of; forks of road at Double Camp Run, north angle, iron post marked "884 GRAFTON" .. 884.007

Weston Along Baltimore and Ohio Railroad and Highways South to Arnold, thence Southeast to Burnsville, thence Northwesterly Along Highways via Sandyfork to Linn.

Feet.

Weston, 0.45 mile south of; railroad bridge No. 25 C, south abutment, northeast corner, chiseled square 1017.67
Brownsville, covered bridge at; 3.4 miles south of Weston, west abutment of bridge, northeast corner, chiseled square 1028.11
Rohrburg, in front of station; top of rail 1036.5
Watson crossing, top of rail 1049.0
Roanoke, 0.4 mile north of; iron bridge over Canos river, north abutment, southeast corner, chiseled square 1048.25
Roanoke, 1.8 miles southwest of; 0.6 mile northeast of Arnold, railroad bridge No. 38 B over Monongahela river, southwest corner of southwest pier, bronze table marked "1058 GRAFTON" 1057.970
Confluence, 2.6 miles northeast of; 4.6 miles southwest of Arnold, on Second Big Run, railroad bridge No. 43 A, over, southwest corner of east abutment, chiseled square .. 803.18
Confluence, 0.4 mile northeast of; railroad bridge No. 46 A. (opposite forks of county road), north corner of pier, chiseled square 777.26
Confluence, 0.8 mile southwest of; railroad bridge No. 47 A, at forks of road, northwest corner of west pier, chiseled square 775.67
Confluence, 4.2 miles southwest of; 0.5 mile north of Burnsville, railroad bridge over Little Kanawha river, No. 50 A, top of east corner of northeast pier, bronze tablet marked "765 GRAFTON" 764.616
Stouts Mills, iron bridge over Little Kanawha river, northwest corner of east abutment, bronze tablet marked "750 GRAFTON" 749.874
Linn, near, iron bridge over Leading Creek; southeast corner of north abutment, chiseled square 774.80

Burnsville Southeast Along Road to Bulltown, thence West to Point 1 Mile North of Rollyson.

Feet.

Bulltown, Little Kanawha river at; covered bridge over Little Kanawha river, north of west abutment, 9.8 feet

below bridge seat, and 8.1 feet west of corner, bronze tablet marked "777 GRAFTON"..................... 776.788
Rollyson, 0.01 mile north of; railroad bridge No. 57 D, northeast corner of south abutment of bridge seat, bronze tablet marked "797 GRAFTON"............................ 796.934

Burnsville South Along Baltimore and Ohio Railroad and Highways to Rollyson.

Feet.

Burnsville, 1.7 miles south of; railroad bridge No. 52 A, over Salt Lick Fork, northwest corner of south abutment, chiseled square.................................... 765.14
Cozers, 3.4 miles south of; railroad bridge No. 55 D, over Salt Lick Fork, northeast corner of south abutment, chiseled square.................................... 785.71
Cozers, 5 miles south of; railroad bridge No. 57 D, northeast corner of south abutment, chiseled square............... 796.92

Rollyson South Along Baltimore and Ohio Railroad and County Roads to Birch River.

Feet.

Heaters, highway bridge over Bryan's Fork at; southeast corner of west abutment, chiseled square................ 865.22
Shaversville, Dr. B. M. Squire's Drug Store; 0.8 foot west of and 3.5 feet south of northwest corner, iron post marked "1071 GRAFTON"...................................... 1070.900
Flatwoods, 1.6 miles south of; railroad bridge No. 64 B, northeast corner of south abutment, chiseled square.... 1052.07
Sutton, 2.3 miles north of; 3.7 miles south of Flatwoods, railroad bridge No. 66 D, northeast corner of south abutment, chiseled square................................ 863.42
Sutton, suspension bridge over Elk river at; north face of north tower, 0.9 foot above foundation and 2.4 feet east of corner, bronze tablet marked "843 GRAFTON"...... 842.840
Sutton, 8.05 miles south of; about 160 feet north of Bear Run, 50 feet north of road forks, left side of road, outcrop of rock, bronze tablet marked "1073 GRAFTON".. 1072.938

Line Leaves Road and Crosses Fields and Little Birch River, to Mouth of Laurel Run, thence by Road up Run.

Feet.

Birch river, 300 feet north of post office, on east side of Powell Creek, 0.2 mile north of mouth, opposite Ivan Brothers and Brown's store, in outcrop of rock, aluminum tablet marked "1108 KNWA"........................ 1108.728

KANAWHA, CLAY, NICHOLAS, FAYETTE AND GREENBRIER COUNTIES.

Kanawha Falls and Nicholas Quadrangles.

The following elevations are based on a bronze tablet set in

Lock No. 2, Kanawha River, marked "614 KNWA.," the elevation of which is accepted as 614.205 feet above mean sea level. This elevation is based on a United States Engineer's bench mark, also set in Lock No. 2.

The leveling was done under the general direction of Mr. Albert Pike, topographer, by Mr. Hargraves Wood, levelman.

All bench marks dependent upon this datum are marked with the letters "KNWA," in addition to their figures of elevation.

Lock No. 2, Kanawha River, East on Kanawha and Michigan Railway to Gauley Bridge, thence on Chesapeake and Ohio Railway up Gauley River via Belva to Zela.

	Feet.
Kanawha River, Lock 2, near north end and in east face of masonry; bronze tablet, marked "614 KNWA"........	614.205
Harewood, 600 feet east of coal tipple; north end of culvert of Kanawha and Michigan Railway, in top of coping; aluminum plug, marked "638 KNWA"................	637.928
Kanawha Falls, 180 feet south of flag station of Kanawha and Michigan Railway and 200 feet north of road crossing of railroad, on west side of Kanawha and Michigan Railway, nearly opposite house of T. W. Farley; in face of rock at base of cliff; bronze tablet, marked "667 KNWA"	667.121
Gauley Bridge station, on Toledo and Ohio Central Railway, at west end of bridge over highway, in south face of abutment at top step of wing wall; aluminum tablet, marked "677 Kanawha"............................	677.086
Belva, Nicholas road station; at Chesapeake and Ohio Railway bridge over Gauley River, in south abutment of south face; bronze tablet, marked "711 KNWA"...........	710.506
Belva, 4.8 miles east of, also ½ mile northeast of mouth of Elk Creek, 15 feet northwest of road; aluminum plug in ledge of rock, marked "752 KNWA"..................	751.806
Lockwood, 0.1 mile west of; on north side of road opposite L. N. Simm's house; 200 feet east of R. L. Dickson's house, at east foot of Summers Hill; in ledge of rock on north side of road; bronze tablet, marked "1088 KNWA"....	1087.625
Lockwood, ¾ mile east of; at top of hill 100 feet east of church; stone at root of oak tree, marked "1260"........	1259.83
Winston, ¾ mile east of; 100 feet west of Jones Fork, on east side of church on north side of road; nail in root of small oak tree, maked "1180"......................	1180.21
Zela, 0.1 mile east of and 300 feet west of Crosslanes road; in field 50 feet south; large sandstone rock in which aluminum tablet is placed, marked "1267 KNWA"...........	1267.646

Zela East on Pike to Summersville.

	Feet.
Gilboa, 0.1 mile east of; rock on north side of road 100 feet west of McVine's Branch, marked "1299"	1298.54
Gilboa, 1.3 miles east of; 200 feet west of top of hill, on north side of road; nail in root of large chestnut tree, marked "1508"	1508.23
Gilboa, 2.5 miles east of; on north side of road, opposite mill and road running south; nail in root of small white-oak tree, marked "1496"	1496.24
Enon post office, 1 mile east of; at crossing of Pine Run and northwest angle of road to Muddlety Creek; nail in root of sycamore tree, marked "1525"	1525.05
Summersville; court house front; at east side of door in base of pilaster, aluminum tablet marked "1894 KNWA"..	1893.808

Zela, via Keslers Crosslanes and Carnifax Ferry, to Mount Lookout.

	Feet.
Zela, 3.3 miles south of; top of mountain, head of Whitewater Creek, north side of road; nail in root of white-oak tree. marked "1662"	1661.80
Keslers Crosslanes, at store and crossroads 600 feet south of; 100 feet south of S. P. Campbell's house, on west side of road in ledge of rock; brass plug, marked "1567 KNWA"	1567.409
Keslers Crosslanes, 1 mile south of; road running east and west; at northeast angle, nail in root of white-oak tree bearing sign "To Summersville, 8 miles," marked "1553"	1552.53
Keslers Crosslanes, 2 miles south of; on east side of road, opposite settlement road; nail in root of black-ash tree, marked "1681"	1680.900
Carnifax Ferry; south side of Gauley River, east side mouth of Meadow River, west side of road to Mount Lookout; nail in root of small white-birch tree, marked "1190"....	1189.77
Carnifax Ferry, 1.2 miles south of and 200 feet north of big cliff, on east side of road; nail in root of white-oak tree, marked "1503"	1503.17
Carnifax Ferry, 2.2 miles south of; on east side of road, opposite house; nail in root of beech tree at gate, marked "1866"	1866.32
Mount Lookout, at east side of road to Pool and north side of road to Summersville; spike in stump of large oak tree, marked "1964"	1964.16
Mount Lookout, 1.1 miles southeast of; angle to road running southwest; nail in root of poplar tree, marked "2038"..	2037.12

Mount Lookout, via Pool, to Fowlers Knob.

	Feet.
Mount Lookout, 1.6 miles south of; schoolhouse 250 feet	

south of; on east side of road; small ledge of rock; aluminum plug in, marked "2069 KNWA" 2069.402
Mount Lookout, 2.8 miles southeast of; road runninig south; stone at northwest corner, marked "2101" on stump.... 2100.458
Pool, 0.1 mile north of; on east side of road; nail in chesnut marked "2145" 2145.40
Pool, 2.6 miles north of; road south to Russellville, at top of hill; nail in wood plug at base of signboard........... 2394.24
Fowlers Knob, 400 feet south of; on east side of road, just north of small branch; aluminum plug in large ledge of rock, marked "2195 KNWA" 2195.382
Fowlers Knob, 1 mile south of; opposite small house 0.2 mile north of Homing Falls road; nail in root of stump on east side of road, marked "2338" 2338.29

Fowlers Knob, via Anglins Creek Bridge and Millers Ferry, to Russellville.

Feet.

Fowlers Knob, 2.5 miles south of; road running south, at southeast angle; nail in chestnut, marked "2215" 2215.217
Fowlers Knob, 3.1 miles south of; road running west, at store at southwest angle; stone, marked "2208" 2207.78
Fowlers Knob, 4 miles south of; 3 miles north of Anglins Creek bridge, opposite milldam on west side of road; nail in locust, marked "1923" 1922.94
Fowlers Knob, 5.2 miles south of; about 1 mile north of Millers Ferry, top of mountain on east side of road; chestnut, marked "2307" 2306.86
Millers Ferry over Meadow River, 0.1 mile north of; on east side of river on west side of road; aluminum plug in ledge of rock, marked "1905 KNWA" 1904.943

Russellville, Over Mountain, to Riverside.

Feet.

Russellville, 90 feet north of; on east side of road, west side of river; aluminum tablet in ledge of rock, marked "1900 KNWA" 1900.123
Russellville, 3.7 miles south of; on east side of road between log house and frame house; nail in root of chestnut, marked "2721" 2721.26
Russellville, 4.7 miles south of and 60 feet north of church; south side of road running south to Clifftop; nail in maple, marked "2782" 2781.81
Russellville, 6.7 miles south of; top of mountain 300 feet north of school house; nail in tree on east side of road marked "2982" 2982.09
Riverside at Meadow River, 150 feet northwest of; ford 800 feet east of; on west side of road, between house and barn,

one of several ledges of rock; aluminum plug in, marked ''2324 KNWA'' 2324.014
Riverside, 2 miles east of; at fork of road, running northwest; nail in locust bearing sign ''to Riverside 2 miles,'' ''to Russellville 12,'' ''to Clifftop 11,'' ''to Burdett's Mills 2½,'' marked ''2723'' on sign board............. 2723.19

Riverside, Road near Burdett's Schoolhouse, via Bear Garden Ridge, on Trail and Old Road to Snowhill.

Feet.

Riverside, 3.8 miles east of; Burdett's schoolhouse, 1.4 miles east of; gap in ridge east of Bear Garden Knob; nail in chestnut marked ''3046''............................ 3045.59
Riverside, 5.3 miles east of; Burdett's schoolhouse, 2.9 miles northeast of, on Collison Ridge, 1.2 miles east of Pittsenberger's house, white linden tree, marked ''3154''.... 3153.87
Nicholas road, 1.4 miles southwest of; at southwest corner old road and trail on Collison Ridge; large red oak tree marked ''3318''.................... .... 3318.35
Nicholas road, 0.6 mile southwest of; on south side old road on top of small knob; maple tree, marked ''3405''.. 3405.54
Snow Hill, 8.8 miles southeast of; at northwest intersection Nicholas road and road to Nuttersville; 500 feet north of Grig M. Clung's house; copper plate in large sandstone rock, marked ''3392 KNWA''...................... 3391.855
Snow Hill, 6.9 miles southeast of; on west side of road; 1.1 miles north of trail running east to Beech Knob; maple tree, marked ''3243''.............................. 3243.58
Snow Hill, 6.5 miles southeast of; Greenbrier and Nicholas county line; corner stone top of; marked in red chalk ''3129'' 3129.00
Snow Hill, 5.5 miles southeast of; Homing Falls road, 0.9 mile southeast of; on west side of road; chestnut tree, marked ''3023'' 3023.43
Snow Hill, 4.4 miles southeast of; road running east to Homing Falls, at southeast angle of; white oak tree, marked ''2806'' 2805.93
Snow Hill, 3.4 miles southeast of; road to Homing Falls 1 mile northwest; 700 feet northwest of house on east side of road; chestnut tree marked ''2899''.................... 2899.04
Snow Hill, 2.6 miles southeast of; opposite road running east; small chestnut tree, marked ''2854''............ 2853.78
Snow Hill, 2 miles southeast of, at forks of road running west; chestnut tree bearing sign ''to Russellville, 12 miles,'' ''to Ruperts, 16 miles;'' marked ''2940''........ 2940.44

Snow Hill on Nicholas Road to Fork of Road 1 Mile Southeast of Fowlers Knob.

Feet.

Snow Hill post-office, 200 feet southwest of; 535 feet north of

road running west on west side of Nicholas road; aluminum bolt in rock, marked "2943 KNWA" and "B.M., U. S. G. S." painted on rock.............................. 2943.583

Snow Hill, 0.7 mile north of; at southeast angle road running east; chestnut bearing sign "to Homing Falls 2 miles, to Rupert's, 18 miles;" marked on sign board "2850".... 2850.25

Snow Hill, 1.6 miles northwest of; northwest angle of road running north, 150 feet west of new schoolhouse and near sign "to Summersville, 15 miles;" chestnut tree, marked "2838" 2838.13

Snow Hill, 2.6 miles northwest of; 850 feet west of Jones's house on north side of road; nail in root of stump, marked "2606" 2605.76

Snow Hill, 3.3 miles northwest of; southeast angle of road running southwest; small black oak tree bearing sign "to Summersville, 13 miles," "to Eyes Mill, 2 miles"...... 2492.67

Snow Hill, 5.2 miles northwest of; at southeast angle of road running east; at deserted store; chestnut marked "2434" 2434.28

Snow Hill 1.6 Miles Northwest of; toward Ophelia.

Feet.

Snow Hill, 1.7 miles northwest of; top of hill north of new schoolhouse 2838.13

Snow Hill, 2.6 miles northwest of; 1 mile north of new schoolhouse; Odd's store, southeast corner foundation stone of, marked "2711"................................. 2711.47

Road running north, at southeast corner at sign, "to Summersville, 13 miles, to Irondorfs Mills, 1½ miles;" stone, marked on sign "2536"............................ 2536.37

Homing Creek, bridge over; west end of west retaining wall on north side of road; stone, marked "1840"......... 1840.15

Homing Creek, 1.9 miles east of; 500 feet east of trail to Homing Falls, north side of road; chestnut tree, marked "2657" 2656.93

Ophelia, ¾ mile south of; at crossroads to Leivasy and Summersville, near church; stone.......................... 2623.84

Ophelia, ¾ mile south of; 1,500 feet west of crossroads and church, at west side of farm road, 50 feet north of Summersville road; bolt in rock, marked "KNWA 2587".... 2587.132

Crossroads ¾ Mile South of Ophelia to Leivasy.

Feet.

Ophelia, 1.7 miles southeast of; at southeast angle of road running northeast; large poplar tree, marked "2721".... 2721.378

Ophelia, 2.4 miles southeast of; 100 feet southwest of road on east; on north side of road; maple tree, marked "2694" 2694.49

Ophelia, 3.08 miles southeast of; road running north; chestnut tree, marked "2747" on stump.................... 2746.83

Ophelia, 0.4 mile south of; 300 feet north of road to Cherry river and church; east side road, marked "B. M." on rock 2379.04
Leivasy; store opposite to stone at gate, marked "2358".. 2357.69
Leivasy post office, ½ mile south of; at fork of road to Hominy Falls and Lile; at southeast angle, marked "B. M." on rock..2368.86
Leivasy post office, 1½ miles southeast of; at log schoolhouse at north side of road; stone marked "2406" on schoolhouse 2405.81
Leivasy post office, 2½ miles southeast of; trail 0.1 mile southeast of white oak tree, marked "2605" on south side of road 2605.39
Leivasy, 4 miles southeast of; chestnut tree bearing sign "to Leivasy 4 miles; to Rupert's 20 miles;" point on rear of tree, marked "3004" on sign board.................... 3004.53

Leivasy, via Lile, to Beech Knob.

Feet.

Lile, 0.8 mile west of; and Greenbrier and Nicholas county line, stone, 0.15 mile east of; about 600 feet west of store on southwest side road; chestnut marked "3342"....... 3342.29
Lile, 0.6 mile west of; 130 feet west of trail running south on south side of road; chestnut tree marked "3319"...... 3319.34
Lile, 0.95 mile east of; oposite road running east and on west side of road to Beech Knob; beech tree, marked "3500" 3499.78
Lile, 1.6 miles east of; at road running west and 60 feet east of branch; dead maple tree, marked "3848"........... 3848.19

Beech Knob, at Road Running West, to Duo.

Feet.

Beech Knob, 1.1 miles south of; near small branch, on west side of road; maple tree marked "3394"............. 3393.97
Beech Knob, 2 miles south of; 40 feet south of Long Branch crossing on east side of road; beech tree, marked "3219" 3219.20
Duo, ½ mile northwest of; fork of road to Rupert, 200 feet north of; 100 feet north of branch and 50 feet east of road, near small house, bolt in bowlder, marked "3206 KNWA" 3206.454

Beech Knob at Road Running West on Big Mountain Ridge Southwest to McClung and Snow Hill Road.

Feet.

Beech Knob, 1.3 miles southwest of; and 20 feet west of faint trail on south side of road; beech tree, marked "3783"... 3783.

Summersville, Up Muddlety Creek, to Hookersville.

Feet.

Summersville, brickyard and house between at road east; west side of small bridge, nail in, marked "1888"....... 1887.578

Summersville, road east; nail in fork of oak, marked "1938" 1938.14
Summersville, farm road east of, at northeast angle; black oak, marked "1984" 1984.06
Phillips Run, fork of road at and bridge over Muddlety; large pin-oak tree, marked "1836" 1835.66
Muddlety post office, ½ mile north of; school 50 feet north of, west side of road, at small stream, beech, marked "1861" 1860.80
Muddlety post office, road west to Clay Court House, opposite to small crabapple tree, on east side of road, marked "1854;" also ¼ mile north old Valley House 1854.51
Hookersville, at road running east up Muddlety, at southeast angle; white oak tree, marked "1856" 1855.83
Hookersville, 200 feet west of road to Powell Mountain, at intersection road up Muddlety; aluminum tablet in rock in field, marked "1859 KNWA" 1859.496

Point 6 Miles North of Summersville to Buffalo, at Mouth of Dog Run.

Feet.

Muddlety road, 1 mile west of; first house on Clay Court House road, 150 feet north of; at cut-off trail, chestnut tree, marked "1925" 1925.13
Pearson Branch, near top of mountain, at head of hollow, 200 feet south of trail to; on west side of road, stone marked "2360" 2359.81
Birch Run, 30 feet north of, on east side of road; trail west at top of ridge, at top of last ascent before reaching Birch Run; chestnut tree, marked "2025" 2025.35
Beech Run, at crossing north side of run and west side of road at end of foot log; small beech, marked "1636" 1636.16
Beech Run, crossing about 2,000 feet north of; on south side of road opposite Liberty Bowl schoolhouse; aluminum tablet in large rock marked "1747 KNWA" 1746.593
Liberty Bowl schoolhouse, 0.7 mile north of; stream 600 feet north of, on east side of road at old road; gum tree, marked "1795" 1795.50
Clay-Nicholas county line, on north side road; large oak tree, marked "1727" 1726.95
Dog Run, or Clay; deserted store and road running northeast; large chestnut tree, marked "1710" 1710.47
Enoch post office, road to; 25 feet north of, on north side of road; large white oak tree, marked "1483" .... 1482.69.
Dog Run, between second and third crossing, descending on east side of road, about 1 mile northwest of Enoch church; beech tree, marked "1117" 1117.46
Buffalo, northwest side of, and opposite point 60 feet north mouth of Dog Run; in Rock Cliff, aluminum tablet, marked "826 KNWA" 826.124

Summersville, Over Powell Mountain, to Birch River and Welch Glade.

	Feet.
Hookersville, about 2½ miles north of; top of Powell Mountain, on south side of road; small iron-wood tree, marked "2484"	2484.25
Hookersville, clearing about ½ mile north of, on east side of road; rock marked "2316"	2316.15
Powell Mountain; road opposite to Strange creek, on west side road to Sutton; aluminum bolt in small ledge of rock, marked "2249 KNWA"	2249.18
Strange Creek, road ¾ mile north of; first crossing of branch about 100 feet south of, on west side of road; small beech tree, marked "1951"	1950.89
Powell Mountain, foot of; ½ mile above; opposite house in bottom on west side road, small oak tree, marked "1363".	1363.01
Powell Mountain, foot of; near schoolhouse on east side of road; small oak tree, marked "1224"	1224.05
Birch Run post office, about 300 feet north of; on east side of Powell Creek, about ¼ mile north of mouth, and oppo- Ivan Bros. and Brown's store, aluminum tablet in outcrop of rock, marked "1108 KNWA"	1108.365
Birch River post office, 1¼ miles east of; ¼ mile east of Anthony, opposite to church on south side of road; double sycamore tree, marked "1134"	1134.15
Birch River, about 3 miles east of; at mouth of Rose Run, on north bank of the river; sycamore tree at foot log, marked "1196"	1195.76
Skiles Branch, 250 feet east of mouth; poplar tree, marked "1253"	1253.47
Birch River, about 6 miles east of; about 1-3 mile above Rich Fork, on southwest side road; beech tree near house, marked "1332"	1331.75
Boggs post office, 1¼ miles west of; at Roughs of Birch River, 150 feet east of falls and sawmill on south side of road; beech tree, marked "1495"	1495.23
Boggs post office, near; about 250 feet east of school, 20 feet north of road in outcrop of rock; bronze tablet, marked "1555 KNWA"	1555.35
Boggs, 1 mile east of; near branch and opposite house on north side of road; stone in fence, marked "1589"	1589.15
Boggs, about 3¼ miles east of; 500 feet above fourth house below foot of mountain on west side of road; birch tree, marked "1750"	1750.37
Boggs, foot of mountain; about 1 mile below and at third crossing below same on east side of road; marked "1889"	1888.53
Welch Glade, about 1 mile northwest of; 725 feet southeast of road from top of mountain to Cowen and Glade Run; about 500 feet southeast of house and ¼ mile northwest of	

church on east side of road; bronze tablet in rock, marked "2253 KNWA" 2253.310
Welch Glade post office, about 800 feet northwest of; nail in floor of bridge, marked "2223"...................... 2222.72
Welch Glade post office, about 100 feet north of; railroad crossing between road to Camden and railroad; oak tree, marked "2222" 2222.32

Welch Glade, via Camden, to Craigsville.

Feet.

Welch Glade, about $1\frac{1}{4}$ miles south of, on road to Camden; small beech tree 250 feet south of, and 50 feet north of road to sawmill site and on north side of road; small white-oak tree, marked "2275"............................. 2274.64
Camden on Gauley; at "The Camden," west side in pier to porch; bronze tablet, marked "2062 KNWA"........... 2062.025
Camden on Gauley, 1 mile west of; roads to Craigsville and up Strouds Creek at southwest angle; oak tree, marked "2099" 2098.81
Camden on Gauley, about 2 miles west of; foot log over Rock Camp Run; nail in east end of; marked "2170"........ 2169.57
Craigsville, about $1\frac{1}{4}$ miles east of; bridge over Rock Camp Run; nail in west end of; marked "2203"............. 2203.57
Craigsville, east end of point on tramway; nail in cross tie.. 2282.52
Craigsville; at road to Cranberry at Hickman's store; small oak tree southwest angle of, marked "2293"........... 2293.36
Craigsville, near east end of; 670 feet east of Cranberry road and hotel; on north side of road in front of Macon Bose's house; bronze tablet in rock, marked "2288 KNWA".... 2288.157

Craigsville, up Beaver Creek near Delphi, and Down Muddlety Creek to Hookersville.

Feet.

Craigsville, west end of; west of tramroad and church; nail in stump of telegraph pole on north side of road....... 2311.75
Craigsville, about $\frac{1}{2}$ mile northwest of; at fork of road south to Beaver Mills on road southeast to Craigsville; near crossing of tramroad at southwest angle of roads; white-oak tree, marked "2337"............................. 2336.13
Craigsville, about $1\frac{1}{2}$ miles northwest of; at top of mountain on west side of road; gum tree, marked "2435"........ 2435.12
Craigsville, about $2\frac{3}{4}$ miles northwest of; at northeast angle of road east and west; small white-oak tree, marked "2196" 2195.73
Delphi, about 1 mile south of; in Beaver bottom, near cross fence; wood plug.................................... 2199.79
Delphi, $1\frac{1}{2}$ miles west of; on north side of road opposite house; at foot of street; nail in root of stump, marked "2251" 2250.62

Delphi, about 2¼ miles west of; on top of mountain, 500 feet west of house on south side of road; chestnut tree, marked "2504"	2503.45
Hookersville, about 5 miles east of; 225 feet east of fork of Muddlety, at crossing of right fork, on north side of road west of crossing; aluminum tablet in large overhanging rock, marked "2005 KNWA"	2004.842
Hookersville, about 4 miles east of; about 80 feet east of crossing of Muddlety, opposite cliffs on south side of road; water birch tree, marked "1939"	1938.61
Hookersville, 2¼ miles east of; 200 feet east of schoolhouse at northeast angle of road to mill; oak tree, marked "1880"	1880.41
Hookersville, 1½ miles east of; south of road between large house and cabin; large leaning maple tree, marked "1863"	1863.15

Craigsville, via Woodbine to Richwood.

	Feet.
Craigsville, point on tramway, east end of	2282.52
Craigsville, 40 feet east of trail on south side of road; near broken down house; white oak tree, marked "2426"	2426.06
Craigsville, sawmill site, trail to; on north side of road; rock, marked "2239"	2238.87
Woodbine post office, rear of; on west side of road; rock marked "B. M.," with "1938" marked on blacksmith shop	1937.65
Woodbine, 1 mile southeast of; opposite to Iron and Sulphur Springs and on east side of road; maple tree, marked "2522"	2521.61
Woodbine, 2¼ miles southeast of; at northwest angle of trail west of Cherry River and near house; rock marked "2849"	2848.49
Woodbine, about 3 miles southeast of; 100 feet south of trail running east on southwest side of road; chestnut tree, marked "2914"	2914.34
Woodbine, 4½ miles southeast of; at trail west; maple tree, marked "2969"	2967.19
Woodbine, 4½ miles southeast of; on Greenbrier road at west side of, and on south side of trail running west, in hollow near maple tree, marked "2969;" bronze tablet in rock, marked "2969 KNWA"	2969.33
Richwood, about 2¾ miles north of; 300 feet north of Pocahontas road on northeast side Greenbrier road near house; stump marked "2972"	2971.82
Richwood, about 2 miles north of; 90 feet south of church on west side of road; oak tree, marked "2976"	2975.74
Richwood, about 1¾ miles north of; beginning of descent at trail southwest and south of house on west side of road, chestnut tree, marked "2937"	2936.88
Richwood, about ½ mile northeast of; 100 feet southwest of	

trail south, south side of road; rock, marked "2400".. 2400.05

Richwood, Cherry River north side of; on east side of road; walnut tree, marked "2189"................... 2188.85

Richwood via Cold Knob and Jones Knob to Duo.

	Feet.
Richwood, 1 mile south of, on east side of road; rock marked "2589"	2588.49
Richwood, 1¾ miles south of; top of Greenbrier-Nicholas county line; stone, marked "2874"...................	2874.02
Richwood, about 2½ miles south of, at Little Laurel Creek bridge over west end and north side of; nail in floor, marked "2746"	2745.97
Richwood, about 3½ miles south of, and about ½ mile north of Babies Hotel on east side of road, opposite to road running west; maple tree, marked "3195".................	3194.94
Richwood, about 6 miles south of, on south side of road to school; top of stump, marked "3713"..................	3712.72
Richwood, about 7¼ miles southeast of, on Manning Knob and east side of road; maple tree, marked "3912".....	3912.05
Richwood, about 7¾ miles southeast of, about 2,350 feet southeast of Manning Knob on northeast side of road; aluminum plug in large rock, marked "3709 KNWA " and "B. M." painted on rock; this bench mark is also 240 feet from foot of descent from Manning Knob going southeast	3709.043
Richwood, 9 miles southeast of, about 1¾ miles southeast of Manning Knob and ¼ mile northwest of trail south; rock on east side of road, marked "3805" on larger rock..	3804.71
Richwood, 10 miles southeast of; about 2¾ miles southeast of Manning Knob on a level stretch of road where it runs east; on north side small beech tree, marked "3893"....	3893.32
Richwood, 11¾ miles southeast of; about 2 miles northwest of road to Duo and 1,000 feet south of cleared field on east side of road; maple tree, marked "3895"........	3895.29
Richwood, about 13 miles southeast of; about ¾ mile northwest of road to Duo at foot of climb going toward Cold Knob in clearing on east side of road; locust tree, marked "3795"	3795.36
Richwood, about 13¾ miles southeast of; on southwest side of Greenbrier road; 795 feet northwest of road to Duo; aluminum tablet in rock, marked "4116 KNWA"......	4116.433
Duo, 7¾ miles east of; about 300 feet east of Summit of Grassy Knob, on south side of road; chestnut oak tree, marked "4347"	4346.68
Duo, about 5½ miles east of; between Grassy Knob and Jobs Knob; about 200 feet west of house and 50 feet north of road; maple tree, marked "4015"....................	4014.84

Duo, about 4½ miles east of; near top of Jobs Knob, on south side of road; large rock, marked "4252".......	4252.06
Duo, about 3½ miles east of; in gap between Jobs Knob and Shell Camp Ridge on south side of road; gum tree, marked "3955"...............................	3955.22
Duo, 1½ miles east of; on Shell Camp Ridge near spring and on south side of road; maple tree, marked "4014".....	4013.93
Duo; on center of bottom step on front porch of house, marked "3428"	3427.55
Duo; check on bench mark plug in rock ½ mile northwest of Duo	3206.454

Leivasy Northeast up Road Crossing Grassy Creek.

	Feet.
Leivasy; church at fork of road about ¼ mile north of; at top of hill; poor road; chestnut tree, marked "2494"...	2494.00
Grassy Creek crossing, about 900 feet east of; on north side of road up Grassy Creek; aluminum tablet in rock, marked "2426 KNWA"; bench mark painted on the rock.......	2425.873

KANAWHA, PUTNAM, LINCOLN, BOONE, LOGAN, MINGO, WYOMING, McDOWELL AND MASON COUNTIES.

Charleston and Oceana Quadrangles.

The elevations in the following list were published in part in the Appendix to the Eighteenth Annual Report of the Survey, being based on a bench mark determined by trigonometrical leveling by the United States Coast and Geodetic Survey at St. Albans west base monument. The leveling in connection with this work was done chiefly by Mr. Hargraves Wood, levelman, under the direction of Mr. Hersey Munroe, topographer, during the seasons of 1896 and 1897.

In the spring of 1898 Mr. E. L. McNair, levelman, connected levels brought from Hamden Junction bench mark of the transcontinental line of precise levels of the United States Coast and Geodetic Survey, via Thurman and Gallipolis, Ohio, to Point Pleasant, West Virginia. At this place connection was made with bench mark of the United States engineers on coping of Lock No. 11, on Great Kanawha River. The result was a difference of 4.780 feet, which is added to the elevations determined by the United States engineers on Great Kanawha River, and a permanent bench mark was left in Point Pleasant bearing the accepted elevation as brought from the Coast Survey. The ele-

vations listed in the appendix of 1897 above referred to, as based on the Coast Survey monument at St. Albans, showed a difference of elevation between it and the United States engineer lock bench marks of 3.544 feet, whereas the difference now accepted is 4.780 feet. As a consequence, the levels hereafter listed differ from those published in the appendix referred to by the amount 0.836 foot, which is added to those elevations, and they are accordingly about 1 foot higher than the elevations as stamped on the bench marks established in 1896 and 1897. Based on these connections, the elevation of the datum tablet placed in the State capitol building in Charleston in 1897, and marked "C. 602," is now accepted as being 601.597 feet above mean sea level. The bench marks dependent upon this datum have been marked with the letter "C" in addition to the figures of elevation.

Lock No. 6 to Charleston.

	Feet.
Lock No. 6, Great Kanawha River; top of coping stone. A correction of 4.780 feet as determined at Lock No. 11 on the Great Kanawha River was added to the elevation of the coping of Lock No. 6 near Charleston. The elevation of coping of Lock No. 6 by the Engineer Corps is 565.5. The corrected elevation is	569.355
Lock No. 6, 0.9 mile east of; chisel mark on rock ledge 15 feet north of road and 700 feet west of tannery	621.925
Charleston, 2¾ miles northwest of; chisel mark on sandstone from north wall of stone arch bridge over Two Mile Creek. Bridge is known as Two Mile Bridge	596.105
Charleston, 2.4 miles northwest of; nail in top of oak post 2 feet high, beside sidewalk on south side of road 18 feet west of corner of Tinsley's grocery	618.815
Charleston; 1¼ miles northwest of State Capitol; chisel mark on sandstone wall at southeast corner of stone arch bridge. About ½ mile northwest of suspension bridge across Elk River	593.695

Charleston up Twomile Creek and Along Charleston and Sissonville Road to Wallace's Store on Tupper Creek.

	Feet.
Charleston, State Capitol, in southwest corner of; bronze tablet marked "602 C"	600.672
Twomile Bridge, 1 mile north of; chisel mark on sandstone abutment at northwest corner of wooden bridge, opposite road going east up branch	586.615

Twomile Bridge, 2 miles north of; chisel mark on sandstone bowlder at southwest corner of small wooden bridge near wood-colored house on west of road..................	603.845
Twomile Bridge, 2¾ miles north of; about 200 feet southwest of Methodist church known as Wesley Chapel; copper bolt in bowlder marked "604 C"..................	603.826
Wesley Chapel, 1-3 mile north of; chisel mark on bowlder near middle of road and 10 feet north of elm tree; 400 feet northwest of store................................	606.425
Wesley Chapel, 1½ miles north of; chisel mark on sandstone bowlder 2½ feet from walnut tree (near bridge) on east side of road opposite house of G. W. Jenkins.........	677.975
Wesley Chapel, 2½ miles north of; chisel mark on large sandstone ledge 20 feet east of road and about ¼ mile southeast of divide between waters of Two Mile Creek and Tupper Creek	806.255
Wallace's store, 0.9 mile south of; chisel mark on large flat bowlder 8 feet northeast of road near small wooden bridge; a log house 275 feet south.........................	744.945
Wallace's store. 75 feet east of; chisel mark on sandstone bowlder on edge of creek 10 feet east of road.........	677.305
Wallace's store. ¾ mile east of; copper bolt in bowlder on south edge of road and about 600 feet east of James Wallace's house, marked "668 C".......................	666.752

Wallace's Store on Tupper Creek, via Martins Branch and Pocatalico River to Poca.

	Feet.
Martins Branch road, south side of and ¼ mile above mouth; 175 feet west first crossing near schoolhouse; copper bolt in rock ledge 1 foot above grade, marked "C 592".....	591.017
Rocky Fork, 300 feet from mouth of; railing post west side bridge (north end) over............................	593.475
Pocatalico River and Lick Branch, summit between; nail in root walnut tree	831.865
Poca, about 3½ miles southeast of; stone on bridge over small stream	566.795
Poca, 1¼ miles southeast of; nail in root of large elm north side of road, south bank Pocatalico River........	570.025

Poca, Along Kanawha and Michigan Railway to St. Albans.

	Feet.
Poca station, 300 feet south of; copper bolt on west side south abutment highway bridge over Correly Branch; marked "C 572".........	572.341
Milepost 107, Kanawha and Michigan Railway, nail in top of	588.845
Milepost 108, Kanawha and Michigan Railway, nail in top of	591.635

Milepost 109, Kanawha and Michigan Railway, nail in top of	590.875
Milepost 110, Kanawha and Michigan Railway, nail in top of	591.845
Lock 7, top coping; equals 555.50 United States Engineer elevation	559.355
Lewis railroad station, ¼ mile east of; nail in root of large walnut tree at bend in lane, 600 feet north of Chesapeake and Ohio Railway	569.905
Scott railroad station, 75 feet south of; iron post in Pine's orchard, 50 feet south of Chesapeake and Ohio Railway tracks, marked "693 C"	692.856
St. Albans, west base monument, located in fence line on west side of First street, 60 feet north of the north rail of the Chesapeake and Ohio Railway track; center of monument is marked by limestone post projecting 1 foot above ground, in top of which is a copper bolt, the elevation of which is	594.691

Lock 6 to Tyler Creek Schoolhouse.

	Feet.
Lock 6, coping; equals 565.50 United States Engineer elevation	569.355
Lock 6, ½ mile northwest of; bridge over small branch of Tyler Creek	588.415
Tyler Creek road, ¼ mile southeast forks of road near Tyler schoolhouse; copper bolt in rock 20 feet west of drain across, marked "C 623"	623.371

Lock 6, up Middle Fork Davis Creek to Mouth of Long Branch.

	Feet.
Davis Creek, southeast abutment Chesapeake and Ohio Railway bridge over (top ballast wall)	603.625
Trace Fork Davis Creek; Kanawha and Coal River Railway trestle over; top of rail	601.135
Milepost 2, top of; Kanawha and Coal River Railway...	596.665
Dry Branch ¼ mile south of; nail in root of beech tree east side of road	596.155
Long Branch, 900 feet north of; between second and third crossings north of schoolhouse; copper bolt in large bowlder west side middle fork Davis Creek, marked "C 659".	659.262

Lock 5, up Lens Creek to Racine and Down Coal River to Mouth of Lick Creek.

	Feet.
Lock 5, coping; equals 572.50 United States Engineer elevation	576.355
Chesapeake and Ohio Railway culvert over Rush Creek; ¾ mile northwest of; copper bolt in middle one of three ledges of rock west side Right Fork Rush Creek, marked	

"C 639"	638.943
Trestle on West Virginia Southern Railroad, 900 feet southwest Chesapeake and Ohio Railway; top of rail	591.925
Hernshaw, ¾ mile south of; nail in root sycamore east side of road at schoolhouse	703.075
Hernshaw, about 1 mile south of; copper bolt in 3 by 5 foot ledge rock south side road south bank Lens Creek, near A. Hoffman's house, marked "C 722"	722.185
Sixmile Creek, ¼ mile south of; large sycamore tree west side of road; nail in root of	868.305
Lens Creek and Short Creek, gap between; center road ground surface	1237.075
Lens Creek and Short Creek, 1-10 mile, south gap between; large flat rock east side of road	1169.285
Racine, about 1 mile north of; nail in root large sycamore tree in road 400 feet south Widow Snodgrass's house	770.285
Racine, 50 feet north of north side church at; on rock west side road 200 feet north Coal River	664.375
Peytona, east end of walnut tree south side of road, nail in root of; third tree from east line walnuts nearly opposite old coal dump across river	669.445
Peytona, about 2 miles northwest; copper bolt in ledge rock south side road down Coal River, 100 feet northwest of Laurel Branch; 1 mile below White Oak Branch, marked "C 665"	665.401
Lick Creek, 200 feet north of mouth of; copper bolt in rock west side Coal River road, marked "C 648"	648.375

Racine, via Comfort and Hopkins, to Mouth Robinson Creek.

	Feet.
Toney Branch Coal River, at crossing; nail in root sycamore tree southeast side of road	671.745
Comfort, ⅛ mile north of; copper bolt bottom rock cliff ½ mile south mouth Joes Creek; east side Coal River road, 4 feet above grade, marked "C 673"	673.488
Laurel Creek crossing, 600 feet below Sand Fork; large leaning poplar tree east side of road, nail in root of	704.655
Hopkins Fork, 200 feet southeast mouth of; bronze tablet in face rock cliff, marked "C 734"	734.388
Cristley Branch; nail in root of beech tree north side Laurel Fork 400 feet southwest schoolhouse at	823.255
Prairie Branch, 300 feet southwest of; nail in root of sycamore tree southeast side of road	887.915
Laurel Fork and Robinson Creek, gap between; nail in root large chestnut tree	1657.325
Robinson Creek, confluence with Right Fork; nail in root of beech tree growing with sycamore tree	875.695

Robinson Creek and Pond Creek, 500 feet from confluence of; copper bolt sunk in protruding bowlder in Ballard Brown's field on east side of and 300 feet from road, marked "C 746" 746.847

St. Albans, via Tackett Creek, Young's Store and Tornado to Starting Point.

	Feet.
St. Albans, west base monument, located in fence line on west side of First street 60 feet north of the north rail of the Chesapeake and Ohio Railway track; center of monument is marked by limestone post projecting 1 foot above ground, in the top of which is a copper bolt, the elevation of which is	594.691
Lewis railroad station, ¼ mile east of; nail in root of large walnut tree at bend in lane 600 feet north of Chesapeake and Ohio Railway................	596.905
St. Albans, 1½ miles northwest of; northeast corner of abutment of bridge at first crossing of Tackett Creek.........	587.985
Tackett Creek, last crossing of; 400 feet west of frame house with well in front; bench mark cut in stone on right side of road..............	777.985
Tackett Creek, road up; rock on right side just above small spring on left side of road 500 feet east of summit; "B M." cut on rock....................................	903.125
Tackett Creek, summit, where road leaves and follows Hurricane, 1,000 feet west of; nail in poplar stump at end of small bridge on left side of road......................	915.795
Hurricane road, right side of; 75 feet beyond new frame house about ½ mile west of summit on ledge rock.......	842.375
Young's store, first house south of, on south side of road, belonging to John Hodges; copper bolt set in east chimney 6 feet from ground, marked "U. S. G. S. 737 Ft. B. M."..	737.294
Young's store, west side of road leaving Hurricane road at; nail in root of gum tree 6 inches in diameter ½ mile south from forks where clearing begins on right..............	812.495
Young's store, road from, to Bridge Creek; large white oak tree on east side 200 feet west of head of hollow on south and backbone of ridge........................	930.115
Bridge Creek, west bank of; south of and near house on east about ¼ mile south of schoolhouse; nail in small dogwood stump	748.525
Flint Hollow, ¼ mile southwest of mouth of; large rock on bank west side of road and Bridge Creek; cleared field on east, woods on west..............................	699.925
Trace Fork of Mud River, 200 feet below mouth of Twomile Branch, 400 feet northwest of Anderson McAllister's house; copper bolt in huge rock on north side of stream,	

marked "U. S. G. S. 669 Ft. B. M."....................669.125
Twomile Branch (a tributary of Trace Fork of Mud River); large elm tree at mouth of.............................. 661.985
Fall Creek, road from; stone on north side 100 feet from top of first ridge near small walnut........................ 1033.905
Twomile Branch and Right Fork of Fall Creek; nail in root of large chestnut tree on south side of road near first break in ascent of ridge between streams...............879.565
Tornado, 2 miles southwest of, on Fall Creek road; nail in root of beech tree on bank near new house........... 620.125
Tornado, 1½ miles southwest of, on road up Fall Creek; iron post on south side of road 150 feet above first crossing of Fall Creek, marked "614"............................ 613.708
Tornado, mill at; large stone in retaining wall of mill at point where wall meets fence........................ 607.205

Garrett's Bend to Sand Gap, Sugar Camp Knob, down Laurel Fork of Horse Creek to Madison.

Feet.

Garrett's Bend, 1 mile southeast of, up Trace Fork; nail in root of sycamore tree, east side of road, near foot-log and sawmill 670.415
Garrett's Bend, south end of first foot log at, going up Trace Fork; nail in stump....................................681.305
Garrett's Bend, 2 miles above; nail in root of walnut tree at barn and crossing at William's Branch............. 703.165
Sand Gap; nail in large stump under chestnut tree west side of road 1088.165
Sand Gap, 500 feet west of, fork of roads at; coper bolt in huge rock above John A. Midkiff's house, marked "U. S. G. S. 1079 B. M."................................ 1078.545
Brushy Knob, east end of, on road to Little Coal River; nail in root of white-oak tree on west side of road..........1222.895
Sugar Camp Knob signal, ¼ mile south of cabin near, 125 feet below fork of road; nail in root of hickory tree on west side of road.................................... 1197.425
Sugar Camp Knob signal, 1¾ miles from, on Laurel Fork; nail in root of beech tree at schoolhouse on west side of road 838.875
Laurel Fork, 1½ miles above mouth of; nail in root of beech tree on east side of road............................... 753.705
Laurel Fork, ½ mile above mouth of; nail in root of beech tree on west side of road............................ 706.045
Laurel Fork, 200 feet above confluence with Horse Creek; copper bolt in rock ledge on east bank, opposite James McClure's house near last crossing of Laurel, marked "U. S. G. S. 673 Ft. B. M."........................... 672.622
Hill, 1½ miles above; nail in root of leaning beech tree on north bank of Horse Creek about 1,200 feet below Price's

house, just below small stream coming in on right........ 651.995
Trace Branch, 1 mile above mouth; copper bolt in large bowlder on left side of right-hand hollow on Trace Branch of Horse Creek, marked "U. S. G. S. 766 Ft. B. M."....765.931
Hill; top of foundation wall north side of store.......... 668.585
Hill, 1½ miles south of; nail in root of large white-oak tree on west side of road ¼ mile south of ford............. 657.615
Camp Creek, ¼ mile north of; nail in root of large sugar maple tree on west side of road 300 feet above Stolling's house.. 662.525
Camp Creek, ¼ mile north of; copper bolt in small ledge of rock on east side of road going up Little Coal River 300 feet above B. Stollings, marked "U. S. G. S. 660 Ft. B. M." 660.170
Camp Creek, ¾ mile south of, opposite Dr. Hill's house; nail in root of large beech tree west side of road............669.765
Camp Creek, 2 miles south of; nail in root of beech tree west side of road..710.715
Lick Creek, 1 mile north of, 600 feet above house where road forks to left; nail in root of hollow beech tree on bank of river west side of road.................... 671.025
Lick Creek, opposite mouth of; nail in root of one of two sycamore trees overhanging river.................... 667.275
Lick Creek, 1¼ miles south of mouth of; nail in root of leaning beech tree on south side of Lick Creek, below small stream coming in on south.......................... 716.875
Lick Creek, 500 feet below sawmill on; nail in root of leaning beech tree on north side of road.................. 743.165
Lick Creek, 3 miles above mouth, at Chamber's house; nail in root of walnut tree in field on north side of road...... 767.405
Lick Creek, 3½ miles above mouth of and ¼ mile above Chamber's house, on Right Fork of Lick Creek; copper bolt in bowlder above coal bank 25 feet east of creek between two walnut trees, one of which is blazed; bolt is marked "U. S. G. S. 820 Ft B. M.".................. 819.403
Newport (Danville post office), ½ mile above; nail in root of large elm tree on south side of road.................. 678.075

Madison, up Spruce Fork to Seng Post-office.

Feet.

Madison, sheriff's office; bronze tablet in front wall, marked "704" 703.221
Spruce Fork, 600 feet above mouth of; nail in root of beech tree on east side of road............................ 698.765
Madison, 1½ miles south of; nail in root of white pine tree on east side of road up Spruce Fork 225 feet above schoolhouse 708.795
Low Gap Branch, 450 feet above mouth; ledge of rock on north side of road................................. 718.745

Spruce Fork, ½ mile below Hunters Branch; nail in root of large, leaning sycamore tree on west side of road, bank of Spruce Fork, 5 feet above water...................... 727.285
Spruce Fork ½ mile above Hunters Branch; nail in root of apple tree 600 feet above log house on east side of road.. 745.365
Spruce Fork, 4 miles below Hewett Creek; nail in root of large sycamore tree 200 feet above schoolhouse....... 743.835
Spruce Fork, 1 mile below mouth of Hewett Creek, nail in root of elm tree on east side of road................... 764.195
Spruce Fork, 200 feet below mouth of Hewett Creek; nail in root of sycamore tree on east side of road in front of schoolhouse 769.225
Spruce Fork, mouth of Dry Branch, near John French Stollings; nail in root of oak tree on west side of road...... 784.975
Spruce Fork, ¼ mile below mouth of Rockhouse Creek; nail in root of water-birch tree on south side of road 200 feet above crossing 815.655
Spruce Fork, ¾ mile above Rockhouse Creek; nail in root of sycamore tree on east side of road 400 feet above cabin on right 827.745
Spruce Fork, ⅛ mile above mouth of Beech Creek on north side of Spruce Fork, 300 feet below splash dam opposite William Coleman's barn; copper bolt in ledge of rock, marked "U. S. G. S. 846 Ft. B. M."................ 845.309

From Mouth of Hewett Creek to Peck and up Guyandot River to Logan.

Feet.

Hewett Creek 300 feet above mouth of; copper bolt in ledge of rock opposite schoolhouse and on south side of creek; marked "U. S. G. S. 767 Ft. B. M."..................... 767.029
Hewett Creek, 1 mile above mouth of; on south side of road 300 feet below French McNealy's; nail in root of leaning beech tree 791.415
Hewett, 1 mile above post-office; nail in root of elm tree on east side of road 1,000 feet below splash dam.......... 827.785
Hewett, 2 miles above post-office; 600 feet below Robert Hardessy's; nail in root of small leaning birch tree on south side of road.................................. 855.225
Hewett Forks, 1½ miles below; nail in root of leaning beech tree on west side of road in front of schoolhouse........ 904.305
Hewett Forks, 1-3 mile above; rock in road near ledge on right with coal under it........................... 1003.645
Hewett and Big creeks, top of ridge between; nail in root of mulberry tree 600 feet below top of ridge on Big Creek side 1166.175
Big Creek, head of; nail in root of chestnut tree on east side of road above Sanders's barnyard..................... 982.315
Mill Creek, head of; nail in root of walnut tree on north side

of road above bend at house near foot of mountain....... 973.27f

Peck, ¼ mile south of post-office; on the northwest side of Mill Creek 300 feet above mouth; copper bolt in northwest corner of huge bowlder, marked "U. S. G. S. 653 Ft. B. M." 652.624

Peck, 1 mile above on Guyandot River; nail in root of beech tree on west side of road........................ 698.545

White's Mill, ½ mile south of; nail in root of large elm tree on west side of road along Guyandot River, 200 feet below schoolhouse 645.195

Logan 1½ miles south of; nail in root of huge sycamore tree on west side of road.................................. 652.035

Logan, 2 miles south of; 500 feet above Hamilton McDonald's; nail in root of beech tree on right of road...... 654.415

Logan, bronze tablet set in wall at northeast corner of courthouse, marked "678" 677.897

Logan to Mouth of Big Huff Creek and up Guyandot River to Gilbert.

Feet.

Logan, 1 mile east of, on road up Guyandot River; large bowlder marked "B. M.", on south side of road......... 668.045

Dingess Run, 200 feet south of; nail in root of large sycamore tree west of road............................ 662.695

Andrew Perry's house, ¼ mile above, on west side of road; nail in root of leaning water birch.................. 674.415

Ely Gore's, across river from, and 500 feet above hollow on left; nail in root of leaning sycamore on west side of road 685.535

Rum Creek schoolhouse, ¼ mile above; rock at root of large cucumber tree on west side of road.................... 687.835

Floyd Buchanan's, top of hill across river from; lower projection on vertical ledge of rock on east side of road.... 772.865

Hugh Avis's, ½ mile above; nail in root of beech tree on west side of road 712.905

Rich Creek, opposite mouth of; copper bolt in rock 20 feet north of Methodist Episcopal Church, marked "U. S. G. S. 725 Ft. B. M."..................................... 724.634

Rich Creek, 1 mile above; rock on right of road, near Melros White's 722.085

Henry Branch, ½ mile above; nail in root of walnut tree on east side of road................................ 755.905

George McDonald's field, cedar tree in, 1,500 feet below his house on the south side of Guyandot River (B. M. 724.465 of N. & W. R. R.); nail in root..................... 730.045

Buffalo Creek, opposite mouth of; nail in root of sycamore tree on south side of Guyandot River, near water's edge. 722.165

Buffalo Creek, ¼ mile above mouth of, opposite Martin Doss's and 60 feet above foot log, on west side of Buffalo; copper bolt in rock, marked "U. S. G. S. 728 Ft. B. M.". 727.586

Buffalo Creek, 2 miles above mouth of; nail in root of syca-

more tree on east side of road....................	784.095
Buffalo Creek, west side of valley, 3 miles above mouth of; copper bolt, marked "U. S. G. S. 808 Ft. B. M."......	807.614
Rockhouse Creek, west side of and 1 mile above mouth; copper bolt in rock near south end of cliff; marked "U. S. G. S. 792 Ft. B. M."................................	791.824
Big Huff Creek, east side of and 300 feet above mouth; copper bolt in rock, marked "U. S. G. S. 727 Ft. B. M."......	727.037
Guyandot River, ½ mile above mouth of Rockhouse Creek; nail in root of small black oak on west side of road.....	736.775
Guyandot River, 200 feet above Wayne McDonald's store; nail in root of small sycamore tree, west side of road....	759.225
Henderson Browning's, ¼ mile below; nail in root of large white oak on south side of road.......................	751.235
Elk Creek, 600 feet below; nail in root of beech tree on west side of road, 300 feet below Emory Altizer's..........	753.425
Spice Creek, ½ mile above; nail in root of white-walnut tree on north side of road, 1 mile below Jim Justice's..	770.105
Guyandot River; large rock on bank of, west side, where road comes near water, ½ mile above Jim Justice's.....	755.665
Gilbert, 1 mile below; nail in root of sycamore tree with speading roots 200 feet above old mill race where wagon road crosses river..................................	803.465
Gilbert, ½ mile below; rock on west side of road 200 feet above high cliff on left...............................	821.505

Gilbert, via Wharncliffe, to State Corner Between Virginia, West Virginia and Kentucky.

	Feet.
Gilbert, opposite Alexander Stafford's store; iron post in field, marked "832".............	831.646
Gilbert, rock on east side of road near top of hill above Stafford's store	854.325
Gilbert Creek, 1 mile above mouth of; rock marked "B.M." in creek and road at first crossing above Zat Ellis' house.	847.125
Gilbert Creek, ½ mile above Horsepen Creek; nail in root of beech tree on east side of road 600 feet below Scott Ellis's	890.555
Twisted Gun Gap Branch, 800 feet below; nail in root of poplar tree on east side of road up Gilbert Creek.........	944.465
Twisted Gun Gap, summit of; nail in root of oak tree on east side of road..................................	1442.565
Ben Creek, head of right fork below deserted cabin; rock on east side of road near rock cut at foot of mountain..	1199.575
Ben Creek, 400 feet below Laurel Branch; nail in root of small white pine on east side of road................	1016.435
Ben Creek, 300 feet below Laurel Branch, 4 miles above Wharncliffe; iron post on east side of road, opposite T. E. Brown's house, marked "1020".................	1019.815

Ben Creek, 400 feet below Pound Mill Branch; nail in root of small sycamore tree on east side of road......	948.165
Ben Creek, 200 feet above Spring Fork Branch; at Michael Hatfield's; nail in root of black-oak tree in west side of road	889.315
Wharncliffe, railroad bridge over Ben Creek; bridge seat of east abutment (B. M. 820.39 of N. & W. R. R.).........	821.975
Kentucky, Virginia and West Virginia, corner of State lines, ½ mile south of Wharncliffe; iron post, marked "825"..	825.162

Kentucky, Virginia and West Virginia Corner, via Mouth of Long Pole, up Same, to near Oak Branch.

	Feet.
Long Pole Creek, 1¼ miles above mouth of; nail in root of beech tree on north side of road.....................	975.275
Long Pole Creek, 1,200 feet below Oak Branch; iron post on south side of road, marked "1050"..................	1050.284

Up Big Huff Creek, via Cyclone, to Its Head and to Echart.

	Feet.
Millard McDonald's, 600 feet below; nail in root of poplar tree on south side of road...........................	770.275
Big Spring Branch, 1,800 feet above crossing of; nail in root of sycamore tree on north side of road................	792.625
Cyclone, copper bolt in rock opposite Henchman's house, marked "U. S. G. S. 854 Ft. B. M."..............	853.992
Ed. Cook's, ¼ mile above; nail in root of beech tree on south side of road................................	896.265
Lem Brown's, ¼ mile above; nail in root of beech tree on south side of road................................	948.585
Lem Brown's; nail in root of poplar tree on south side of road at	993.015
Toney Fork of Huff Creek, south side of, about 2 miles above mouth; copper bolt in ledge of rock, marked "U. S. G. S. 1234 Ft B. M.".............................	1234.489
Road Gap Branch, 600 feet below; iron post on east side of road up Big Huff Creek, 100 feet above D. H. Cook's store, marked "1068"......	1067.600
Rockhouse Branch, 600 feet above at Gordon Burgess's; nail in root of sycamore tree on east side of road up Big Huff Creek	1148.985
Road fork, 1 mile above; nail in root of tall sycamore tree 50 feet to right of road up Big Huff Creek..............	1219.645
Road fork, 2 miles above; nail in root of water birch on north side of road up Big Huff Creek.................	1273.705
Trace Fork, 600 feet above; nail in root of tall sycamore tree on west side of road up Big Huff Creek..............	1374.485
Brushy Fork, 100 feet above mouth of, opposite W. R. Blankenship's; nail in root of sycamore tree east side of Big Huff Creek	1482.665

Laurel Branch, ¼ mile above and a little below Garden Branch, on east side of Big Huff, about 600 feet below Bailey's; nail in root of sycamore tree, east side of road.. 1605.515
Spring Branch, 1,000 feet above mouth; nail in root of beech tree with top off, on west side........................ 1815.085
Spring Branch; nail in root of sugar maple, half way up mountain above head of stream, toward lowest part of ridge 2346.795
Spring Branch and Alum Dirt Branch, top of ridge between; nail in root of large water oak, 200 yards east of Joe Lusk's deserted house.............................. 2771.595
Alum Dirt Branch, one-third way down mountain toward; nail in root of buckeye tree........................... 2429.095
Echart, east bank of Pond Fork of Coal River, opposite mouth of Skin Fork; copper bolt in ledge of rock, marked "U. S. G. S. 1423 Ft. B. M."............................ 1423.025

Echart, down Pond Fork of Little Coal River, via Bald Knob and Crook, to Mouth of West Fork and up Same to Mouth of Brown's Branch

Feet.

Pond Fork, 1 mile below Skin Fork; nail in root of sycamore tree on east side of road............................ 1352.955
Skin Fork, 3 miles below; nail in root of leaning sycamore tree on east side of road down Pond Fork.............. 1240.995
Rock Lick Branch ¼ mile below mouth of; nail in root of sycamore tree on east side of road down Pond Fork...... 1142.335
Bald Knob, east side of valley at; copper bolt in bowlder opposite Eddy Workman's, marked "U. S. G. S. 1101 Ft. B. M." 1101.055
Hatfield's store, 1 mile above; nail in root of sycamore tree on west side of road, 100 feet above branch.......... 1031.015
Cow Creek, north side of, ¾ mile from mouth and 800 feet from Jim Gunnoe's; copper bolt in ledge of rock marked "U. S. G. S. 1039 Ft. B. M.".................. 1039.095
Hatfield's store, 2 miles below, on west side of Pond Fork and 800 feet above Dick Gerald's; nail in root of leaning sycamore tree east side of road....................... 934.675
White's store, ¼ mile above; nail in root of elm tree with sycamore growing out of it, on east side of Pond Fork.... 893.465
Crook, first crossing of Pond Fork above; nail in root of sycamore tree on west side of road.................... 848.245
West Fork of Pond, 1,000 feet above junction of Pond Fork; copper bolt in rock, northeast side, marked "U. S. G. S. 808 Ft. B. M."............................. 809.014
West Fork of Pond, ½ mile below Brown's Branch; nail in root of sycamore tree on west side of road, 600 feet below John Giles's 863.365
West Fork of Pond, 800 feet below Brown's Branch; copper

bolt in ledge of rock on west side of road a little above and nearly opposite small water mill; bolt is marked "U. S. G. S. 884 Ft. B. M." 884.325

Junction of West and Pond Forks of Little Coal River to Madison.

	Feet.
Bull Creek, 300 feet above mouth; nail in root of leaning water birch on west side of road down Pond Fork......	773.835
Robinson Creek, ½ mile above, and 150 feet above Gusser Gore; nail in root of pine tree right side of road down Pond Fork	760.905
Robinson Creek and Pond Fork, 500 feet from confluence of; copper bolt sunk in protruding bowlder in Ballard Brown's field on east side of and 300 feet from road, marked "U. S. G. S. 746 Ft. B. M."	746.847
Robinson Creek, 1 mile below; nail in root of sycamore tree on north bank of Pond Fork and on south side of road just above schoolhouse	722.265
David Green Branch, 700 feet below on west side of road; nail in root of beech tree with top off, and on east bank of Pond Fork	720.645
Workman Branch, 200 feet above; nail in root of chestnut-oak tree on west side of road down Pond Fork...........	701.385

MINERAL, MORGAN AND BERKELEY COUNTIES.

Frostburg, Flintstone, Pawpaw and Hancock Quadrangles.

The elevations in the following list are based upon a bronze tablet set in the stone work at the northeast corner of Allegany County Court House, Cumberland, Md., marked "C 688". The elevation of this bench mark is accepted as 688.257 feet above mean sea level. The initial points on which these levels depend are various bench marks of the Coast and Geodetic Survey Transcontinental line as shown. The bench marks are republished from Appendices to the 19th, 20th and 21st Annual Reports of the Director of the United States Geological Survey, with elevations corrected in accordance with the 1903 adjustment of the precise level net.

The leveling on the Frostburg and Flintstone quadrangles was done in 1897 under the direction of Mr. J. H. Wheat, topographer, by Mr. Hargraves Wood, levelman; that on the Pawpaw and Hancock quadrangles was done partly in 1898 under the direction of Mr. J. H. Jennings, topographer, by Mr. C. B. Bailey, levelman, the remainder being done in 1899 under the

direction of Mr. W. Carvel Hall, topographer, by Mr. Chas. M. Smith, levelman.

All permanent bench marks dependent on this datum are marked with the letter "C" in addition to the figures of elevation.

Patterson Creek South to Alaska.

	Feet.
Patterson Creek, Baltimore and Ohio Railroad Bridge over Patterson Creek, north end of, north side of track, in ballast wall, copper plug marked "574 C"	574.327
Frankfort (Alaska), 0.5 mile northwest of; in west end of north abutment highway bridge over Patterson creek, copper bolt marked "589 C"	589.527

Hancock to Sleepy Creek Station via Berkeley Springs, Rock Gap and Stotlers Corners.

	Feet.
Berkeley Springs, Morgan county court house; west face of southwest corner stone, aluminum tablet marked "612 C"	612.085
Rock Gap Corners, 700 feet west of Fearnow's house; 10 feet north of road at summit of gap, in rock, aluminum tablet marked "761 C"	760.946
Stotlers Corners, 0.5 mile north of; at first ford of Sleepy Creek, ledge of rock east side of road, 0.25 feet north of north entrance to ford, in cleft of rock about 4 feet above roadway, aluminum tablet marked "662 C"	662.244

Great Cacapon via Long Hollow Run to Fisher Ford.

(Double targeted spur line.)

	Feet.
Great Cacapon, Md. U. S. C. & G. S. bench mark "C" on lock 55 of dam No. 6	444.128
Fishers Ford, in large boulder southeast corner of road, aluminum tablet marked "MARYLAND 543 C"	543.505

McCoy's Ferry South up Black Creek.

(Double targeted spur line.)

	Feet.
Johnstown, 1.2 miles south of; center of chiseled square on an outcrop of sandstone rock, about 125 feet east of road forks and 2.5 miles west of Hedgesville, three small pines stand just south	561.51
Tomahawk, aluminum tablet set in northeast corner of foundation stone of W. W. Hedges barn, marked "MARYLAND 466 C"	466.577

INDEX

PART I*

*Part II, Elevations Above Tide, was not indexed, but the regions covered is given in the contents.

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